PB87-188389

Superfund Record of Decision (EPA Region 1): Tinkham Garage, Londonderry, New Hampshire September 1986

(U.S.) Environmental Protection Agency
Washington, DC

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EPA/ROD/R01-86/016
September1986

PB87-188389

EPA

Superfund Record of Decision:

Tinkham Garage, NH

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15. SUPPLEMENTARY NOTES

16. ABSTRACT

The Tinkham Garage site encompasses 375 acres of residential and undeveloped land in Londonderry, NH. Approximately 400 people reside within a condominium complex on the western boundary of the site. Additional housing includes private, one-family homes within site boundaries to the north. An unnamed tributary and an attached intermittent stream branch through the condominium complex and discharge into Beaver Brook, which discharges to the Merrimack River further south. The 100-year flood plain forms an approximately 2-acre wetland at the tributary's confluence with Beaver Brook. The flood plain widens considerably south of the complex forming a 66-acre wetland. In addition, a 57-acre wetland exists to the southeast of the site. Some residents within the site continue to use the bedrock aquifer for drinking water purposes. Ground water in the bedrock discharges to the tributary via surface and ground migration. Between 1978 and 1979, waste disposal activities behind Tinkham garage included the direct surface dumping of liquids and sludge from tank truck washings. In April 1978 citizen complaints of foam and odors in a small unnamed brook resulted in a site cleanup and the excavation of a diversion trench to direct surface run-off. The RI, completed in January 1986, documented contamination from volatile and extractable organic compounds associated with ground water in overburden and bedrock aquifers, surface water and in soil located in the field behind Tinkham garage and in the condominium complex.
(See Attached Sheet)

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Record of Decision Tinkham Garage, NH Contaminated Media: gw, sw, soils, sediments wetlands, wood Key contaminants: VOCs, organics, sludge, metals PCBs, TCE		

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16. ABSTRACT (continued)

Specifically, contaminated soil within the complex was associated with the individual domestic waste leaching fields for a number of buildings within the complex. Two other source areas existed within the complex: a refuse area for disposal of soils excavated from the leach fields; and a low lying contaminated swale area in close proximity to the unnamed tributary. The swale is suspected to be another site of direct discharge of liquid wastes to the ground surface. The primary contaminants of concern include: VOCs, organic sludges and metals.

The selected remedial action includes: excavation of approximately 10,800 cubic yards of contaminated soils behind Tinkham garage; field work and analytical modeling to determine the need for the removal of additional, potentially contaminated soils in the condominium complex; onsite treatment of all excavated contaminated soils by either aeration, composting or soil washing; regrading and revegetation of excavated source areas after treated soils have been returned to their original locations; reconstruction of any removed leach fields; restoration of wetlands where contaminated soils are excavated; extraction and offsite treatment of contaminated groundwater at Derry, NH publicly owned waste water treatment works, which may lead to offsite pretreatment; ground water monitoring onsite and offsite. The estimated capital cost is $2,058,000 with annual O&M of $874,000.

RECORD OF DECISION
REMEDIAL ALTERNATIVE SELECTION

SITE: Tinkham Garage, Londonderry, New Hampshire

I am basing my decision primarily on the following documents describing the analysis of cost-effectiveness of remedial alternatives for the Tinkham Garage site:

DOCUMENTS REVIEWED

1. Field Investigation Report for the Tinkham Garage site, Londonderry, New Hampshire, March 7, 1984, prepared for U.S. EPA, Region I, by NUS Corporation, Bedford, Massachusetts.

2. Remedial Investigation for the Tinkham Garage site, Londonderry New Hampshire, January 15, 1986, prepared for U.S. EPA, Region I, by NUS Corporation, Bedford, Massachusetts.

3. Endangerment Assessment for the Tinkham Garage site, Londonderry New Hampshire, May 7, 1986, prepared for U.S. EPA, Region I, by NUS Corporation, Bedford, Massachusetts.

4. Feasibility Study for the Tinkham Garage site, Londonderry, New Hampshire, July 31, 1986, prepared for U.S. EPA, Region I, by Camp Dresser & McKee Incorporated, Boston, Massachusetts.

5. Technical memorandum; Water Level Measurements - Tinkham Garage Site and Ross Drive, July 14, 1986, prepared by U.S. EPA, Region I, staff.

6. Summary of Remedial Alternative Selection (attached).

7. Community Relations Responsiveness Summary (attached).

8. The National Oil and Hazardous Substances Pollution Contingency Plan, 40 C.F.R. Part 300.

DESCRIPTION OF SELECTED REMEDY

- Excavation of approximately 10,800 cubic yards of contaminated soils behind Tinkhams' garage.

- Field work and analytical modeling to determine the need for the removal of additional, potentially contaminated soils in the Woodland Village Condominium complex.

- Onsite treatment of all excavated contaminated soils by either aeration, composting or soil washing.

- Regrading and revegation of excavated source areas after treated soils have been returned to their original locations.

- Reconstruction of any removed leachfields.

- Restoration of wetlands where contaminated soils are excavated.

- Extraction and offsite treatment of contaminated groundwater at the Town of Derry, New Hampshire publicly owned wastewater treatment works, which may be preceded by onsite pretreatment.

- Groundwater monitoring onsite and offsite.

OPERATION AND MAINTENANCE

Operation and maintenance (O&M) will be a necessary component of the long term onsite and offsite monitoring which is to include sampling and analysis. The sampling and analysis will be required to monitor the water quality of residential wells in use on and off site.

DECLARATIONS

Consistent with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), and the National Contingency Plan (40 CFR Part 300), I have determined that the excavation and onsite treatment of contaminated soils and the extraction of contaminated groundwater with offsite treatment at the Town of Derry, New Hampshire publicly owned treatment works is a cost-effective remedy and provides adequate protection of public health and welfare and the environment at the Tinkham Garage site. The groundwater pumping and treatment program will be considered part of the approved action and eligible for Trust Fund monies for the time period necessary to attain target levels, not to exceed 5 years. In addition, the remedy will require future operation and maintenance activities to monitor the water quality of residential wells on site and off site. These activities are eligible for Trust Fund monies for a period of 1 year. The State of New Hampshire has been consulted and agrees with the approved remedy.

I have also determined that the action being taken is appropriate when balanced against the availability of Trust Fund monies for use at other sites.

September 30, 1986
Date

Michael R. Deland
Regional Administrator

SUMMARY OF REMEDIAL ALTERNATIVE SELECTION
TINKHAM GARAGE
Londonderry, New Hampshire

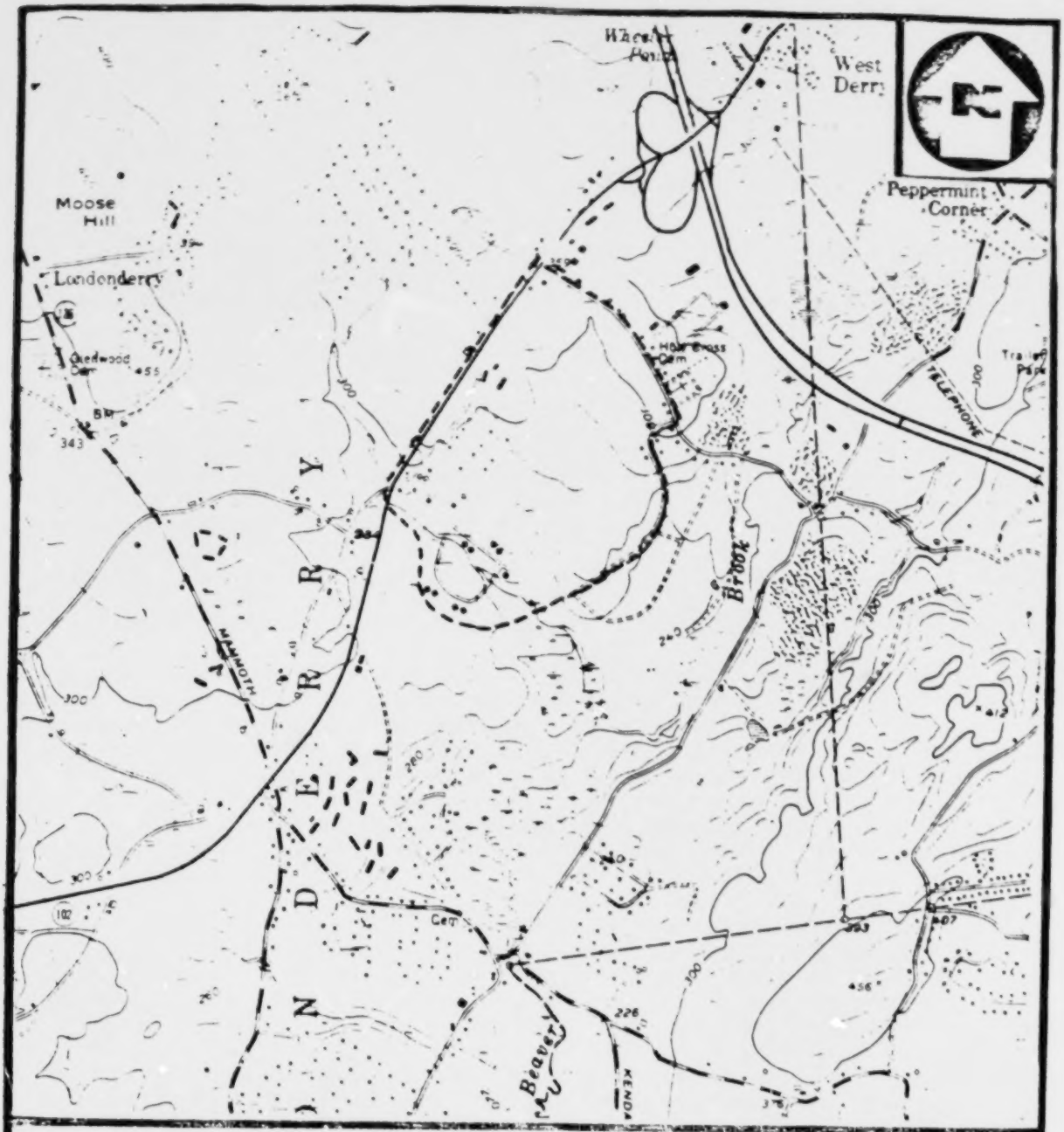
SITE LOCATION AND DESCRIPTION

The Tinkham Garage Site encompasses 375 acres of residential and undeveloped land situated in the southern New Hampshire Town of Londonderry. As shown on Figure 1, the site is approximately one mile southwest of the intersection of Interstate 93 and State Route 102. It is bounded by State Route 102 to the north, Gilcreast Road to the east, Ross Drive to the South and the Woodland Village Condominium complex to the west.

The site includes various developed areas. Approximately 400 people reside within the recently converted Woodland Village Condominium complex (formally Londonderry Green Apartments), which consists of thirteen multi-unit buildings. Additional housing includes private, one-family homes along Mercury and McAllister Drive within site boundaries in the northern sector of the site, and along Gilcreast and Ross Drive bordering the site. Tinkham Realty Office and Tinkham's garage are located in the northeastern sector of the site.

Undeveloped land features include wooded areas, open fields and wetlands. Topography of the site is relatively flat with surface drainage from north to south. An Unnamed Tributary and an attached intermittent stream branch through the condominium complex onsite and discharge off site to Beaver Brook south of Ross Drive. In turn, Beaver Brook discharges to the Merrimack River further to the south. The 100 year floodplain on site extends from Route 102 and follows the Unnamed Tributary along to its confluence with Beaver Brook. The floodplain is generally 100 feet wide along its path through the condominium complex. This area forms an approximately 2 acre wetland. Beyond site boundaries, south of the condominium complex, and prior to the tributary's confluence with Beaver Brook, the floodplain widens considerably forming a 66 acre wetland. In addition, to the south of Tinkham's garage and forming the southeast corner of the site exists a 57 acre wetland (see figure 2).

The primary source of drinking water to the site area, prior to the installation of a permanent waterline, was the bedrock aquifer. Residents along Gilcreast and Ross Drive as well as the Tinkham Realty Company and one private home to the east of the realty office continue to utilize this bedrock aquifer for drinking water purposes. The groundwater flow in bedrock appears to take place largely in fracture zones which have a northeast/southwest orientation. Groundwater in bedrock apparently discharges to the Unnamed Tributary on site from both east and west of the tributary. Additionally, there exist a number of flowing bedrock wells along Mercury Drive and within the condominium complex. Groundwater discharging to the surface from these wells migrates to the Unnamed Tributary via ground surface flow.



SITE LOCATION MAP

NUS CORPORATION
A Halliburton Company

FIGURE 1

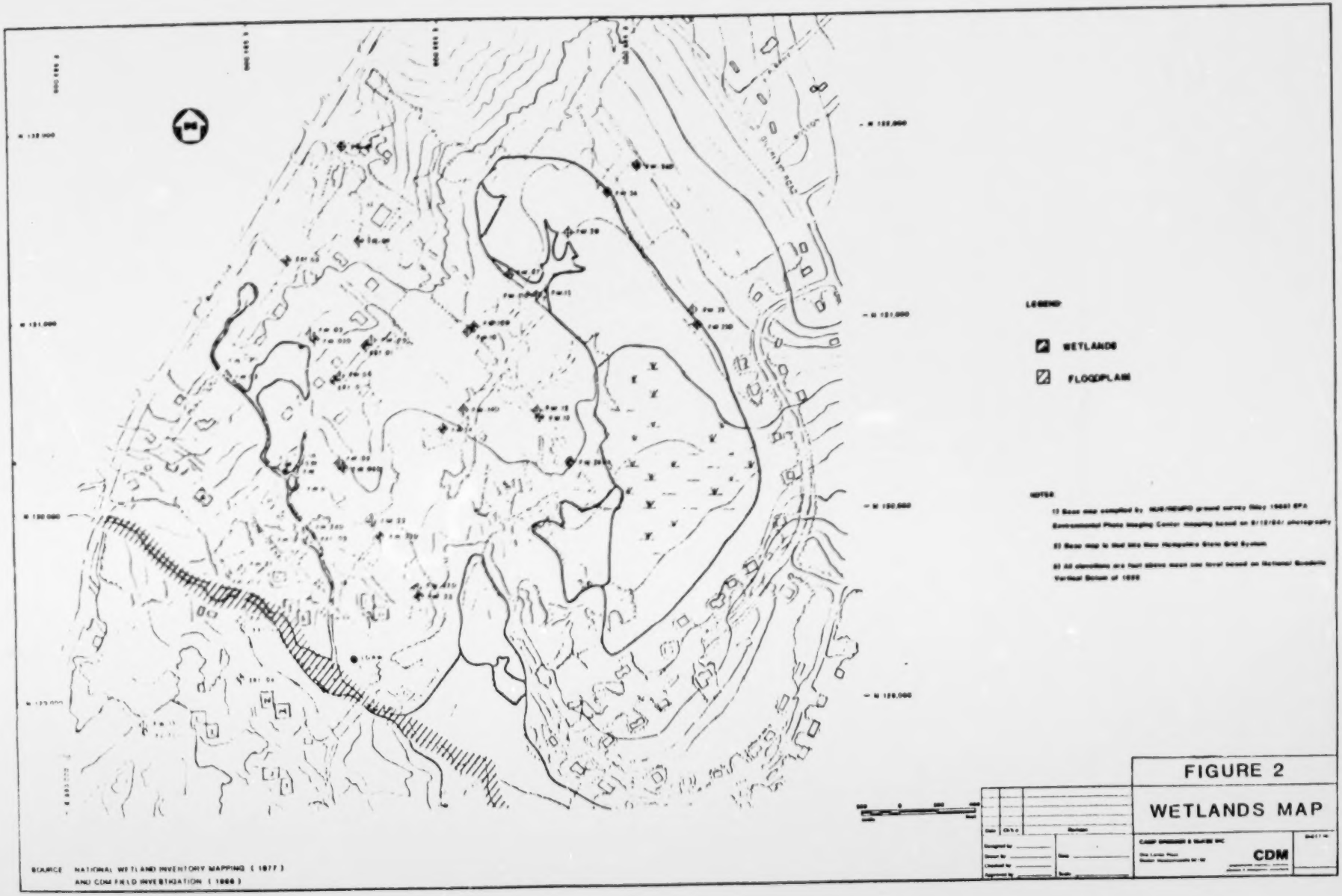


FIGURE 2

WETLANDS MAP

SITE HISTORY

Initial complaints of foam and odors occuring in a small unnamed brook crossing Ross Drive led the Londonderry Health Department to the Tinkham Garage site in April 1978. Their investigation concluded that liquids and sludge from tank truck washings had been dumped behind Tinkham's garage directly to the ground surface. A subsequent citizen complaint to the New Hampshire Water Supply and Pollution Control Commission (NHWS&PCC) resulted in ordering a site cleanup involving removal of surface contamination. Additionally, a diversion trench was excavated to divert surface run-off from behind the garage area away from Ross Drive. It is believed waste disposal practices took place at the Tinkham site during the years 1978 and 1979.

U.S. Environmental Protection Agency involvement with the Tinkham site began in August 1981 as the result of further citizen complaints. A Preliminary Assessment identified groundwater used as a potable water supply, as well as soil and surface water, was contaminated by volatile organic compounds. In January 1983, the drinking water supply well servicing Londonderry Green Apartments (presently Woodland Village Condominiums) and residential wells along Mercury and McAllister Drive were taken out of service because of documented or potential organic contamination. The U.S.EPA temporarily supplied water until a permanent water line was installed by the NHWS&PCC under a cooperative agreement between the State and the U.S.EPA in November 1983.

The Tinkham Garage site was proposed for inclusion on the National Priorities List (NPL) in December 1982, and finalized in September 1983. A Remedial Investigation was begun in the Spring of 1984 and completed in January 1986. The investigation documented contamination from volatile and extractable organic compounds associated with groundwater in overburden and bedrock aquifers, surface water and in soil located in the field behind Tinkham's garage and in the Woodland Village Condominium Complex. Specifically, contaminated soil within the condominium complex was associated with the individual domestic waste leaching fields for a number of buildings within the complex. In addition, there existed two other source areas in the condominium complex. The first source area was a refuse area utilized by the condominium complex and used to dispose of soils excavated from the leachfields. The second source area was a low lying contaminated swale area behind condominium buildings E and F and in close proximity to the Unnamed Tributary. The swale is suspected to be another site of direct dicharge of liquid wastes to the ground surface.

CURRENT SITE STATUS

The results of the Field Investigation (FI), Remedial Investigation (RI) and additional field work conducted during the preparation of the Feasibility Study (FS) identified and verified four distinct contaminated soil source areas (see figure 3). Groundwater contamination was found in both the overburden and bedrock aquifers. Sediment and surface water contamination was found to be associated with the Unnamed Tributary and its attached intermittent stream as well as in wetland areas onsite.

The four soil source areas are the field to the immediate south of Tinkham's garage, the swale area, the soil pile and the domestic waste leaching fields associated with the condominium complex.

- Field Behind Tinkhams' Garage

The areal extent of the source area in the field behind the garage is approximately 29,100 square feet. It is believed that sludge and liquids containing metals and volatile and extractable organic compounds were disposed directly to the ground surface at this location. This is a low lying area and much of it is submerged beneath water during the spring when the water table (which has a seasonally low level of 5-10 feet below the ground surface) rises to the surface. Percolating groundwater is thought responsible for the gradual leaching of surficial contamination to the bedrock aquifer through the relatively permeable sand and the two, relatively low, permeable till layers. The sand and two till layers form that portion of the overburden aquifer behind Tinkham's garage. The overburden and bedrock aquifers are hydraulically connected and downward flow gradients have been noted in well clusters in this source area.

A wide variety of volatile and extractable organics have been documented in this soil source area. Additionally, sediments associated with that portion of this source area that is wetlands have also indicated contamination. It is anticipated that the naturally high organic content of the soils and sediments is responsible for attenuating much of the residual contamination. It is likely that the contaminated overburden provides a continuing source which may leach to the bedrock aquifer.

- Woodland Village Condominium Leachfields

There are thirteen leachfields, lettered A through G and I through N, which provide for domestic waste disposal from the corresponding condominium buildings. These leachfields are underlain by a veneer of sandy overburden of a variable thickness which overlies the fractured bedrock aquifer. This aquifer served as the primary drinking water source prior to contamination. In the past, several of these systems failed for unexplained reasons and were replaced. Additionally, all of the remaining leachfields were repaired or replaced in 1983/1984. It is believed that all leachfields were repaired or replaced

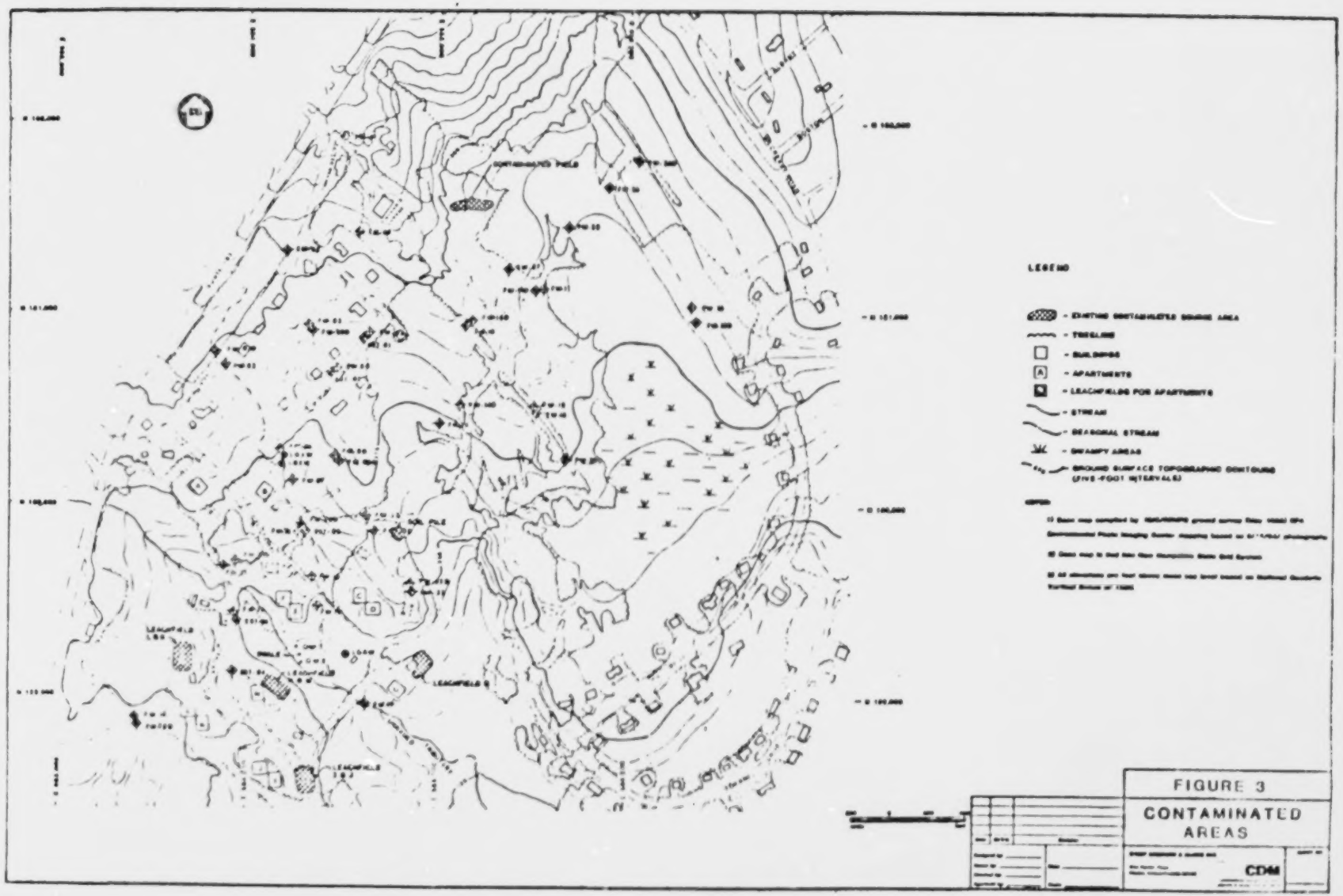


FIGURE 3

CONTAMINATED AREAS

after waste disposal activities ceased in 1979. Based on analytical, hydrogeological and geophysical investigations, it appears that only leachfields G, I/J, K/L, M/N and possibly A continue to be source areas of volatile and extractable organic contamination to the groundwater. However, because of EPA's understanding of the waste disposal practices at this site, and the possibility of incomplete removal of contamination when these leachfields were supposedly replaced, all leachfields are considered suspected source areas. Conservatively, the entire volume of any contaminated leachfield is considered to be the extent of that particular source area. Each leachfield has a lateral surface area of either 5,400 or 7,700 square feet, and a depth from 5 to 10 feet.

- Soil Pile

Soil removed from each replaced leachfield after the introduction of contaminants was buried on the grounds of the condominium complex in a refuse area behind buildings C and D.

Analysis of the soil pile contents is considered indicative of what was discharged to the leachfields and what remaining or residual contaminants most likely exist within the leachfields.

The pile has a lateral surface area of 1,800 square feet, with an average depth to groundwater of 5 feet. It is only slightly elevated, approximately 2 feet above the surrounding ground elevation. Augering revealed a 1 to 2 foot layer of clean fill overlying a plastic cover. The plastic cover and clean fill were placed over the contaminated soil by the owner of the then apartment complex at the request of the NHWS&PCC and EPA in May 1984.

-Swale

The Swale is a low lying area adjacent to the Unnamed Tributary, behind and close to condominium buildings E and F. According to field screening it is composed of two separate areas, one 120 feet by 30 feet and the other 100 ft by 20 feet. Depth to groundwater is approximately 5 feet. This area was covered over with approximately 2 feet of clean fill in 1982. (All documented or potential soil source areas are summarized in Table 1).

- Groundwater (overburden and bedrock)

Overburden groundwater flow over the entire site is migrating towards the south/southeast. Behind the garage, overburden groundwater can potentially discharge to the surrounding wetland or, influenced by downward gradients, migrate into the underlying bedrock. Once the contaminants enter the fractured bedrock aquifer, they migrate in a direction which is approximately perpendicular to the flow in overburden.

TABLE 1

Soil Source Areas

Source Area Location	Lateral Surface Area (ft^2)	Vertical Extent (ft)	Volume (yd^3)
Southwestern Section of a field in back of the Tinkham Garage	29,100	10	10,777
Leachfield A	2,500	10	900
Leachfield B	2,500	10	900
Leachfield C/D	7,700	10	2,900
Leachfield E/F	7,700	10	2,900
Leachfield G	5,400	5	1,000
Leachfield I/J	7,700	10	2,900
Leachfield K/L	7,700	10	2,900
Leachfield M/N	7,700	10	2,900
Solvent Swale	5,600	5	1,000
Soil Pile	1,800	5	700
		Total Volume	29,777

Data gathered from two pump tests have indicated that the flow in the bedrock aquifer is primarily controlled by the alignment of onsite water bearing fracture sets which are oriented northeast/southwest (see figure 4). During the first pump test, well LGSW that was used for a water supply for the condominium complex was pumped. This created a trough of drawdown extending parallel to Mercury Drive to the source area in the field behind Tinkham's garage. This indicates that the condominium complex supply well once used for drinking water is hydraulically connected to the source area behind the garage.

Volatile organic compounds, extractable organic compounds and metals have been identified in groundwater. Levels of total volatile organics have increased throughout the sampling history of the wells on Mercury Drive. This indicates contaminated groundwater continues to migrate from the garage area toward residential wells. Groundwater continuing to migrate from the source area behind Tinkham's garage in fractured bedrock discharges to either the Unnamed Tributary, or to the ground surface through a number of flowing wells along its path (See Figure 5). The discharge of groundwater from the fractured bedrock aquifer to the Unnamed Tributary is substantiated by the presence of upward vertical gradients in wells in this area.

A second pump test was conducted using well LGAW within the condominium complex. This test indicated a second trough of depression running parallel to the first and also indicated an interconnection of wells within and surrounding the complex.

As indicated, groundwater movement in fractured bedrock has been shown to move preferentially in a northeast/southwest direction. However, some groundwater movement can also take place perpendicular to the main fracture sets within secondary fractures. Groundwater movement in secondary fractures coupled with the fact that the Tinkham Garage site is topographically and hydraulically higher than many of the domestic wells in service along Ross Drive, suggests that there is a potential for movement of contaminated groundwater to these wells. A comparison of water level elevations in overburden and bedrock monitoring wells on site and domestic bedrock wells along Ross Drive confirms this potential.

It is suspected that contaminants originating from the leachfields of the complex are transported along with the groundwater through the thin overburden into the bedrock and migrate toward the Unnamed Tributary. Groundwater can discharge to the surface along the way through a number of flowing wells.

Monitoring wells in the vicinity of the soil pile do not indicate contaminated groundwater to be present. However, wells in this vicinity do show downward vertical gradients, so that the soil pile is considered a potential source of contamination to groundwater.

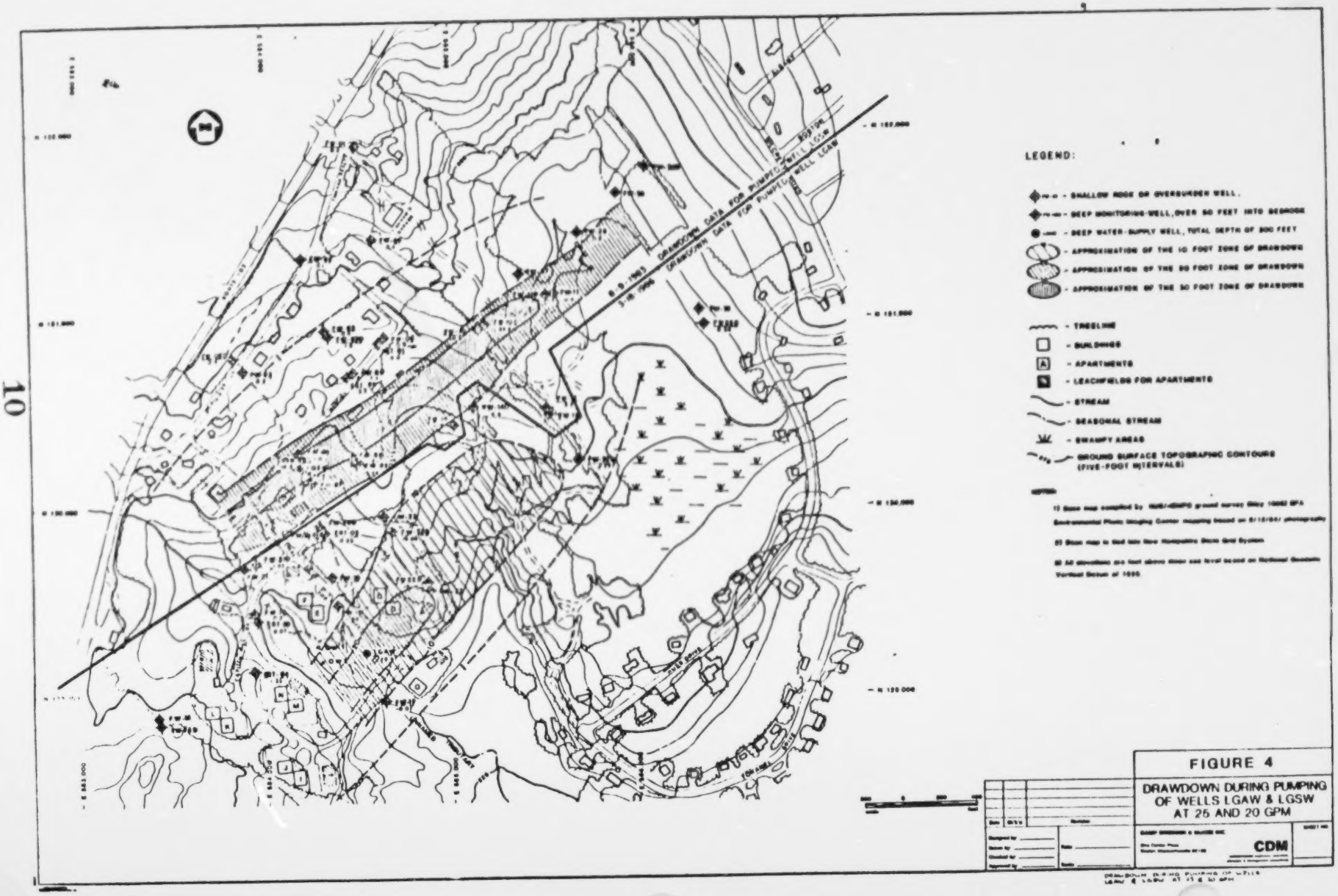
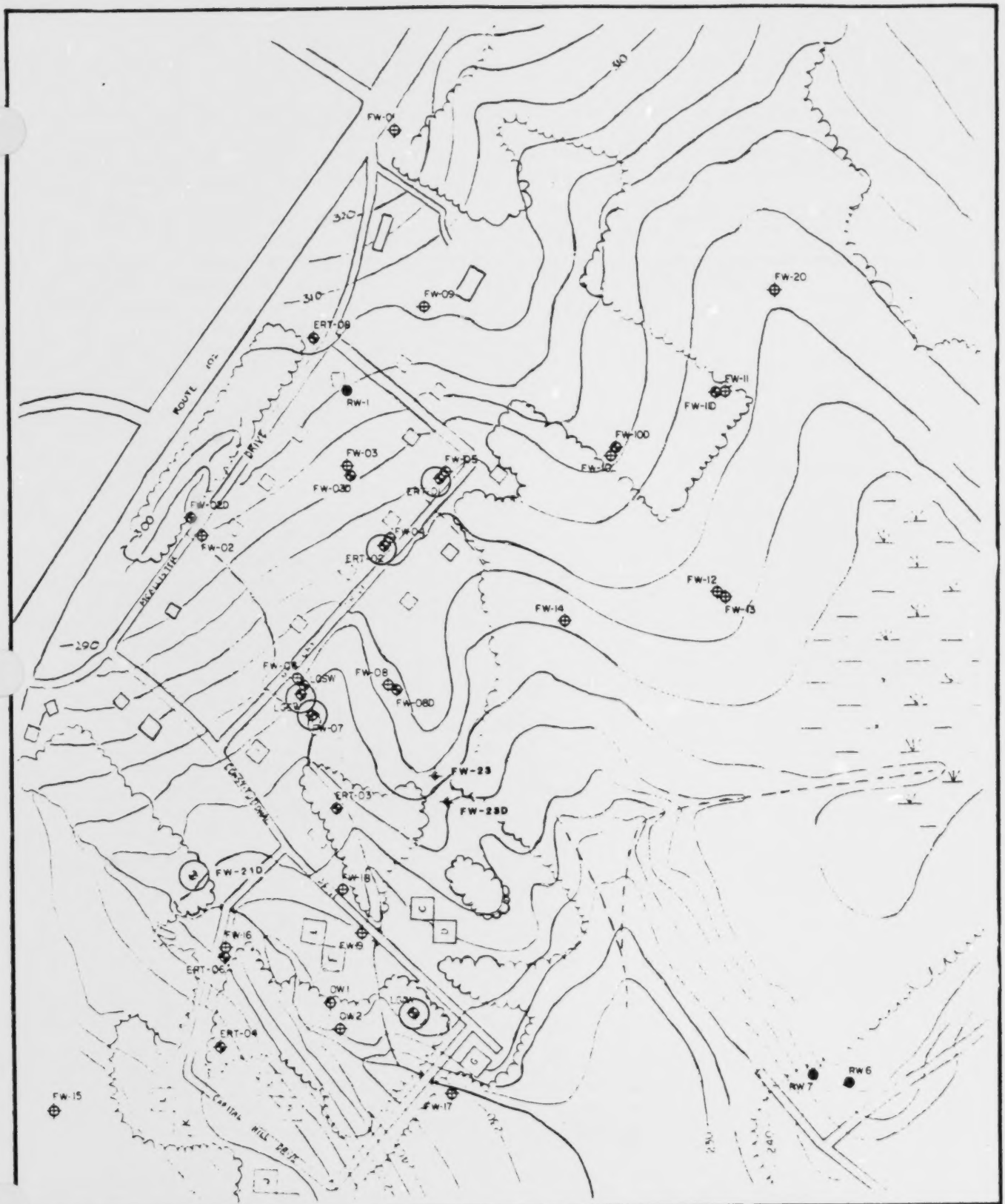

LEGEND:
- SHALLOW ROCK OR OVERBURDEN WELL.
- DEEP MONITORING WELL, OVER 50 FEET INTO BEDROCK
- DEEP WATER-SUPPLY WELL, TOTAL DEPTH OF 800 FEET
- APPROXIMATION OF THE 10 FOOT ZONE OF DRAWDOWN
- APPROXIMATION OF THE 20 FOOT ZONE OF DRAWDOWN
- APPROXIMATION OF THE 50 FOOT ZONE OF DRAWDOWN
- TREELINE
- BUILDINGS
- APARTMENTS
- LEACHFIELDS FOR APARTMENTS
- STREAM
- SEASONAL STREAM
- SWAMPY AREAS
- GROUND SURFACE TOPOGRAPHIC CONTOURS (FIVE-FOOT INTERVALS)
DRAWDOWN DATA FOR PUMPING WELL LGAW
DRAWDOWN DATA FOR PUMPING WELL LGSW
CDM

FIGURE 4

DRAWDOWN DURING PUMPING OF WELLS LGAW & LGSW AT 25 AND 20 GPM



TINKHAM GARAGE SITE
LONDONDERRY, NEW HAMPSHIRE

FIGURE 5

○ - FLOWING WELLS

As previously stated, the Swale is in close proximity to the Unnamed Tributary and is located within the 100 year flood plain. During periods of high flow in the tributary this area can flood, providing a potential source of contamination to the Unnamed Tributary.

Risk Assessment

Volatile organic compounds constitute the predominant contaminants at the Tinkham Garage site. These compounds also present the major risk to public health and welfare and the environment at the site. All contaminants of concern in groundwater identified at the Tinkham Garage site are volatile organic compounds. Some of these compounds are either known human carcinogens or probable human carcinogens. Extractable organic compounds and metals have also been identified. These contaminants have been documented in one or more environmental media onsite.

-Groundwater

The greatest potential risk presented by the Tinkham site is from contaminated groundwater. Groundwater from the fractured bedrock served as the primary source of drinking water prior to 1983 when use of wells onsite were discontinued and an alternate water supply was provided. Groundwater is contaminated by volatile organic compounds, extractable organic compounds and metals. As indicated above, the volatile organic compounds constitute the predominant contaminants. The plume of total volatile organic contaminants are dispersed across much of the site.

Table 2 indicates the contaminants of concern and a historical range of these contaminants identified in groundwater. Table 3 indicates the upper-limit lifetime cancer risk estimates attributed to these contaminants. As can be seen, contaminants range from approximately 1 ppb to 6,700 ppb of volatile organic compounds. Furthermore, based on historical exposure data from residential wells, the upper-limit lifetime cancer risk has been cumulatively estimated at $3x10^{-4}$. Based on environmental monitoring well data it is estimated at $2x10^{-2}$. As a result of this contamination, the bedrock aquifer that served as a water supply for approximately 450 individuals in the rapidly developing, high growth area of Londonderry, is contaminated and undrinkable within site boundaries.

The provisions made in January 1983 to provide residents onsite with an alternative water supply significantly reduced the potential for exposure from contaminated groundwater. However, the exposure potential still remains through the discharge of groundwater to the ground surface in flowing wells onsite, and through the use of private residential wells drawing on this aquifer which remain in service. As indicated, the potential exists for groundwater to migrate to residential wells in use along Ross Drive to the immediate south of site boundaries. (These wells are currently unaffected). Furthermore, this area is one of high growth and developement and the possibilit exists for future construction on site and the subsequent use of this aquifer for drinking water.

TAB[illegible]
OVERVIEW OF CONTAMI[illegible]T CONCENTRATIONS
GROUNDWATER CONTAMINANTS OF CONCERN
TINKHAM'S GARAGE SITE

	Residential Supply Wells		Monitoring Wells	
	Historical Range (ppb)	Date of Highest Concentration	Historical Range (ppb)	Date of Highest Concentration
VOLATILE ORGANIC COMPOUNDS				
Aromatic Hydrocarbons				
Benzene	1.2-8.5	12/82	2-120	6-7/83
Ethylbenzene	2.-8.8	12/82	2-1,400	12/84-1/85
Toluene	2-14	3/83	2-6,000	12/84-1/85
Xylenes (all isomers)	1.5-21	3/83	10-2,200	12/84-1/85
Chlorinated Hydrocarbons				
Chloroform	1-13	2/83	5-34	6-7/83
1,1-Dichloroethane	2-20	8/83	2-1,200	6-7/83
1,2-Dichloroethane	2-10	2/83	2-400	6-7/83
Trans-1,2-Dichloroethylene	2-23	3/83	2.3-6,728	3/83
Tetrachloroethylene	2-7	8/83	4-91	12/84-1/85
1,1,1-Trichloroethane	1-22	2-3/83	2-1,250	3/83
Trichloroethylene	2-180	8/83	4-450	12/84-1/85
Vinyl Chloride	not indentified	N/A	14-230	6-7/83
Halomethanes				
Methylene Chloride	2-290	2/83	2-78	6-7/83
Ketones				
Acetone	2-6300	1/83	2-5,700	6-7/83
2-Butanone (Methyl Ethyl Ketone)	2-670	2/83	1.2-630	6-7/83

TABLE 3
UPPER-LIMIT CANCER RISK ESTIMATES
INGESTION OF CONTAMINATED GROUNDWATER

	Carcinogenic Potency Factor $(mg/kg/day)^{-1}$ [a]	Maximum Concentration Detected in Residential Supply Wells (ppb)	Maximum Concentration Detected in Monitoring Wells (ppb)	Upper-Limit Lifetime Cancer Risk Estimate: Based on Historical Exposure Data [b]	Upper-Limit Lifetime Cancer Risk Estimate: Based on Environmental Monitoring Data [c]
Benzene	0.045	8.5	120	1×10^{-5}	2×10^{-4}
Chloroform	0.070	13	34	3×10^{-5}	7×10^{-5}
1,2-Dichloroethane	0.069	10	400	2×10^{-5}	8×10^{-4}
Methylene Chloride	0.012	290	78	1×10^{-4}	3×10^{-5}
Tetrachloroethylene	0.040	7	91	8×10^{-6}	1×10^{-4}
Trichloroethylene	0.019	180	450	1×10^{-4}	2×10^{-4}
Vinyl Chloride	2.30	not identified	230	not identified	2×10^{-2}
Cumulative Estimate				3×10^{-4}	2×10^{-2}

[a] U.S. EPA, 1984

[b] Based on maximum concentration detected in residential supply wells

[c] Based on maximum concentration detected in groundwater monitoring wells

As yet, no groundwater contamination in either overburden or bedrock has been documented beyond site boundaries. However, well FW-17 to the south of the condominium complex does indicate low levels of volatile organic compounds, and the full extent of the plume in this area is not known.

-Soil

Soil contamination has been documented in the field behind Tinkham's garage, the soil pile, the swale and in a number of leachfields. The primary harm presented by these contaminated soil source areas is the result of their potential to further contribute to the contamination of the overburden and bedrock aquifers. These source areas can potentially leach contaminants to the groundwater resulting in further contamination of the aquifer. As previously stated, downward vertical gradients have been documented in the Tinkham's garage area and within the Woodland Village condominium complex. This enhances the ability of contaminants to migrate through the overburden and into the fractured bedrock aquifer.

The contaminated soil source area in the field behind Tinkham's garage presents the additional risk of direct contact/ingestion of the contaminated media, especially to sensitive populations such as children. The field behind Tinkham's garage presents a significant risk in this regard primarily because of the concentrations of hazardous contaminants, and the presence of these contaminants in surficial media. Contaminants of concern identified within the Endangerment Assessment, which is based on data collected during the Remedial Investigation, are shown in Table 4. Table 5 indicates the upper-limit lifetime cancer risk estimates from ingestion. These contaminants present a worst-case cancer risk estimate of 1×10^{-3} and a more likely cancer risk estimate of 5×10^{-5}.

As can be seen in tables 4 and 5, Polychlorinated Biphenyls (PCBs) were documented onsite. Additionally, PCBs were identified during the FS in contaminated soil behind the garage and in sediments associated with the small pond/wetland of the intermittent stream flowing into the Unnamed Tributary in the condominium complex. Concentrations were found to be less than 1 part per million (ppm) in the majority of samples. A maximum concentration of 15 ppm was detected in one soil sample collected during the FS from behind Tinkham's garage.

The contaminated leachfields, the soil pile and the swale area all associated with the condominium complex are not considered to present a significant direct contact/ingestion risk to public health and the environment. The soil pile and swale are covered over with clean fill and contaminant concentrations do not present a significant direct contact health threat, because of the limited physical access to the contaminated areas. Contaminants buried within the leachfields are covered by a cement cap and top soil. However, as previously stated, the leachfields are considered to be a potentially significant source of past and possible continuing

TABLE 4

OVERVIEW OF CONTAMINANT CONCENTRATIONS

SOIL CONTAMINANTS OF CONCERN

TINKHAM'S GARAGE

	Location[a]	Maximum Concentration (ppb)	Mean Concentration (ppb)
Aromatic Hydrocarbons			
Chlorobenzene	TG	3,600	1,803
1,2-Dichlorobenzene	TG	40,000	40,000
Ethylbenzene	TG	84,000	42,075
Toluene	TG	190,000	95,215
Xylenes (all isomers)	TG	350,000	175,290
Chlorinated Hydrocarbons			
1,1,1-Trichloroethane	TG	16,000	8,007
Trichloroethylene	TG	64,000	21,456
Tetrachloroethylene	TG	200,000 230	57,865
Ketones			
2-Butanone (MEK)	TG	22,000	22,000
Polychlorinated Biphenyls	TG	957	957

[a] TG = Tinkham's Garage Field Area

TABLE 5

UPPER LIMIT CANCER RISK ESTIMATES
INGESTION OF CONTAMINATED SOIL

SOURCE AREA: TINKHAM'S GARAGE FIELD[a]

	Carcinogenic Potency Factor $(mg/kg/day)^{-1}$[b]	Maximum Concentration (ppb)	Average Concentration (ppb)	Upper-Limit Lifetime Cancer Risk Estimate	
				Worst-Case Scenario	More-Likely Scenario
Chlorobenzene	ND[c]	3,600	1,803	-	-
Tetrachloroethylene	0.040	200,000	57,865	8×10^{-4}	3×10^{-5}
Trichloroethylene	0.019	64,000	21,457	1×10^{-4}	6×10^{-6}
PCBs (total)	4.3396	957	957	9×10^{-5}	1×10^{-5}
Cumulative Estimate =				1×10^{-3}	5×10^{-5}

[a] Average and maximum concentrations used to calculate lifetime average exposures are those from sampling conducted by NUS/FIT in March, 1985

[b] U.S. EPA, 1984

contamination to the groundwater. Based on volume and concentratio of contaminants identified to date, these leachfields are probably second only to the field behind Tinkham's garage in their ability to be a continuing source of contamination to the overburden and bedrock aquifers. The swale area and soil pile are also considered to be probable source areas of continuing groundwater contamination. Critical contaminants identified in the condominium complex area (i.e. the leachfields) and in the soil pile, as identified within the RI and EA, are shown in table 6. Screening results from the swale area indicate soil contamination to be present. However, specific contaminants have not been identified.

-Surface Water and Sediments

Surface waters onsite consist of the Unnamed Tributary and the attached intermittent stream, which flow through the condominium complex, and the wetland areas, all previously defined.
In the Unnamed Tributary and intermittent stream, volatile organic compounds were detected in surface water. Additionally, extractable organic compounds and metals were detected in sediments. No contaminants were documented in either the tributary or the stream prior to entering the site north of Route 102. This indicates source areas onsite are the contributing source of contamination to these water bodies and the associated sediments.

Offsite, the Unnamed Tributary flows into Beaver Brook. Historic sampling shows no contamination in the Brook.

Surface water and corresponding sediment samples were collected in the wetlands associated with the field behind Tinkham's garage. Volatile organic and extractable organic compounds were identified in both surface water and sediments. This contamination is attributed to the discharge of overburden groundwater flow to this area.

Contaminants detected in onsite surface waters and associated sediments do not present a signficant risk to public health and welfare and the environment. With time, removal of the source areas and groundwater treatment the low contaminant levels present would be expected to decrease to nondetectable levels.

TABLE 6

OVERVIEW OF CONTAMINANT CONCENTRATIONS

SOIL CONTAMINANTS OF CONCERN

TINKHAM'S GARAGE SITE

	Location[a]	Maximum Concentration (ppb)	Mean Concentration (ppb)
Aromatic Hydrocarbons			
Chlorobenzene	WV	8	8
Ethylbenzene	WV	1,700	897
Toluene	WV	640	640
Xylenes (all isomers)	WV	4,200	2,175
Chlorinated Hydrocarbons			
1,1,1-Trichloroethane			
Trichloroethylene	WV	3	3
Tetrachloroethylene	WV	230	58.3
	SP	27	27
Polychlorinated Biphenyls	WV	86	86
	SP	225	225

a

WV = Woodland Village Condominium Area
SP = Soil Pile

ALTERNATIVE EVALUATION

-Remedial Objectives

According to 300.68(a)(1) of the NCP, the primary objective of an appropriate response is defined as being:

> ...consistent with permanent remedy to prevent or minimize the release of hazardous substances or pollutants or contaminants so that they do not migrate to cause substantial danger to present or future public health or welfare or the environment.

In general, such a response includes source control measures, which address source areas of contamination, and management of migration measures, which address media or areas that have been impacted by the migration of contaminants away from source areas.

Consistent with the NCP, remedial response objectives have been set forth at the Tinkham site for the four documented or potential source areas (i.e. field behind Tinkham's garage, the leachfields, swale and soil pile) and management of migration for groundwater.

-Source Control Objectives

The remedial response objectives for source control measures include: 1) preventing or mitigating further release of contaminants to surrounding environmental media; and 2) eliminating or minimizing the threat posed to the public health, welfare, and environment from the source area.

The first objective, preventing or mitigating further release of contaminants to surrounding environmental media, entails addressing the migration pathways affecting contaminated soil source areas at the Tinkham Garage site. The primary migration pathway identified at the Tinkham Garage site is the transport, via downward migration of contaminants from the soil in all four documented or potential source areas into the groundwater in the overburden and bedrock aquifers. Therefore, the first source control objective is to clean up contaminated soils to prevent or minimize the transport of soil contamination into the groundwater through this pathway. This source control objective complements the management of migration objectives discussed below.

The second objective, eliminating or minimizing the threat posed to the public health and welfare and the environment from the source areas themselves, entails addressing the exposure pathways, receptor populations and levels of exposure associated with the four soil source areas. Human health risks are the primary concern of this objective. The Endangerment Assessment conducted at the Tinkham site addressed risks associated with direct contact/ingestion of soil and groundwater.

Although the risks associated with ingesting the soil are of concern, it has been concluded that the likelihood for the continued release

of contaminants to the groundwater and the associated potential human health risks from drinking the water are of the greatest concern to public health, welfare and the environment. As such, source areas will be remediated based on the first objective stated above (i.e., prevention or mitigation of further release of contaminants to the underlying bedrock aquifer). Direct contact/ ingestion risks are considered in selecting the appropriate extent of remediation in the field behind Tinkham's garage.

Clean up levels in soil have been proposed which are intended to provide a level of clean up which will minimize the potential for further release to groundwater.

Tetrachloroethylene (PCE) and trichloroethylene (TCE) concentrations in both soil source areas and in groundwater will be used as indicator compounds for remediation. The characteristics which qualify these two compounds to be used as indicator compounds at the Tinkham site are:

- They may present major health risks to existing and potential receptor populations
- They occur in high concentrations onsite
- They occur in all media sampled
- They have lower vapor pressures and solubilities than other frequently occurring contaminants such that their natural transport away from source areas is slower than of the other volatile organics

Remediation of soil source areas will be evaluated in terms of the reduction in levels of PCE and TCE, with the underlying assumption that treatment to target levels for these compounds will result in non-hazardous levels of other contaminants.

Source control measures will address soil above the seasonal low water table (the unsaturated zone) and management of migration responses will address contamination in the saturated zone of the soils below the seasonal low water table. This is based on the fact that data from soil sampling efforts indicate that the highest levels of contamination are in the unsaturated zone with a tenfold reduction below the water table. A comparison of the average concentration of total volatile organics in the unsaturated zone above the seasonal low water table versus the saturated zone suggests that the unsaturated zone contains 70% of contaminants by weight. It is anticipated that contaminants which have leached from the unsaturated zone to the saturated zone can be managed using groundwater remediation measures (Management of Migration).

-Management of Migration Objectives

The remedial response objectives for management of migration measures include: 1) preventing or mitigating further migration of contaminants

beyond their current extent, and 2) eliminating or minimizing the threat posed to the public health, welfare and environment from the current extent of contaminant migration.

The first objective, preventing or mitigating further migration of contaminants beyond their current extent, entails addressing the migration pathways affecting contaminated groundwater on site. These pathways include: further transport within the bedrock aquifer via groundwater flow through bedrock fractures (of special concern is transport to residential wells along Ross Drive); surficial exposure of contaminated groundwater via the vertical upward component of groundwater flow in artesian wells located on site (i.e. in the condominium complex and along Mercury Drive), and migration to surface water via groundwater recharge to the Unnamed Tributary.

The second objective, eliminating or minimizing the threat posed to the public health, welfare and the environment from the current extent of contaminant migration, entails addressing the exposure pathways, receptor populations and levels of exposure associated with contaminated groundwater. Human health risks are the primary concern.

For similiar reasons discussed under source control objectives, PCE and TCE will also be used as a guide to remediating the groundwater. The target level for groundwater remediation is 5 ppb for PCE and TCE. The proposed maximum contaminant level (MCL) for TCE is 5 parts per billion (ppb), while the proposed MCL for PCE is not yet available. (MCLs are standards developed under the Safe Drinking Water Act (SDWA) for public water supplies. The standards are based on health and technological and economic feasibility). The same clean up approach can be taken for PCE as TCE since these two compounds have similar weight of evidence for their carcinogenicity, practical quantification level and treatment efficiency. (Note: at this time 5 ppb is the contract laboratory analytical detection limit for both TCE and PCE). The Resource Conservation and Recovery Act (RCRA) requires the setting of a groundwater protection level that is protective of public health and the environment. The groundwater protection standard must be set at background, MCLs or Alternate Concentration Levels (ACLs). EPA considers the setting of target levels at proposed MCLs to be equivalent to ACLs.

The incremental lifetime cancer risk developed in the FS from ingestion of TCE and PCE at 5 ppb each in groundwater is approximately 9×10^{-6} assuming additivity. The actual risk from exposure to groundwater contaminated with these two chemicals will depend on their relative concentrations at point of monitoring. For remediation purposes, 5 ppb for trichloroethylene and 5 ppb for tetrachloroethylene are target levels to be achieved in the groundwater within the overburden and bedrock aquifers within every well on site.

Treatment to 5 ppb for PCE and TCE is expected to reduce other compounds identified in groundwater to non-detectable levels. However, in the unlikely event other compounds are at detectable levels upon meeting the PCE and TCE target remedial objectives for groundwater it will be necessary to determine the overall risk associated with all compounds detected.

22

A determination will be made by EPA upon achieving 5 ppb of PCE and TCE in groundwater as to whether the aquifer clean up has satisfied remedial objectives and to assure that water quality is adequately protective of the public health and welfare and the environment.

Technology Development and Screening

"Guidance of Feasibility Studies Under CERCLA" and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) 300.68,(f) sets forth the process by which remedial actions are evaluated and selected.

The development and screening procedure for the selection of an alternative as specified in the FS Guidance Manual consists of a six step process:

1 - Identify site problems and pathways of contamination

2 - Identify general response actions to meet clean up goals

3 - Identify and screen technologies applicable to wastes and site conditions

4 - Development of alternatives for source control and management of migration remedial actions

5 - Initial screening of alternatives

6 - Detailed analysis of alternatives

Field work detailed within both the RI and FS reports supply the information necessary for step 1.

Steps 2 through 6 of the process were carried through the FS independently for source control and management of migration responses. The preferred alternative selected for the Tinkham site consists of one source control alternative and one management of migration alternative.

General response actions, identified as response categories within the FS, are based on the findings of field work conducted. Technology screening considers the waste-limiting (waste characteristics that limit the effectiveness or feasibility of a technology) and site-limiting (site characteristics such as soil permeability that preclude the use of a technology) factors unique to the Tinkham site, and the level of technical development for each technology. Chapter 3 of the Feasibility Study report details this process.

Tables 7 and 8 summarize the general response categories and the applicable technology screening for source control and management of migration.

Technologies which emerged from this screening process were combined into source control and management of migration alternatives. This process is detailed in the second-half of Section 3 of the FS.

TABLE 7

REMEDIAL TECHNOLOGY TECHNICAL SCREENING
FOR SOURCE CONTROL

Remedial Technologies Applicable for Consideration for Source Control	Remedial Technologies Technically Feasible for Source Control
NO ACTION	NO ACTION
Site Security	Site Security
CONTAINMENT	CONTAINMENT
Capping	Capping
Permeable Cap	Permeable Cap
Multilayered Systems	Multilayered Systems
Surficial Stabilization	Surficial Stabilization
INSITU TREATMENT	INSITU TREATMENT
Treatment Technologies (Biological, Chemical, Physical)	Treatment Technologies (Biological, Chemical, Physical)
Immobilization Technologies	Separation Technologies
Cement and Silicate Based Fixatives/Grouting	Aeration
Thermoset Fixatives/ Polymerization	Soil Flushing
Vitrification	
Artificial Ground Freezing	
Insitu Heating	
Separation Technologies	
Aeration	
Soil Flushing	
Detoxification Technologies	
Aerobic Biodegradation	
Anaerobic Digestion	
Enzymatic Degradation	
Oxidation	
Reduction Dechlorination	
Neutralization	
Hydrolysis (base-catalyzed)	
Enhanced Photolysis	

TABLE 7 (Continued)

Remedial Technologies Applicable for Consideration for Source Control	Remedial Technologies Technically Feasible for Source Control
REMOVAL	REMOVAL
Excavation	Excavation
ONSITE STORAGE	ONSITE STORAGE
Waste Pile Storage Vault Storage Bins Storage Bags Tank/Drum Storage	Waste Pile Storage Bins
ONSITE TREATMENT	ONSITE TREATMENT
Treatment Technologies (Biological, Chemical, Physical)	Treatment Technologies (Biological, Chemical, Physical)
Immobilization Technologies Cement and Silicate Based Fixatives/Grouting Thermoplastics Thermosets Fixatives/ Polymerization Surface Macroencapsulation Absorbents Vitrification	Separation Technologies Drying Beds Pressure Filtration Evaporation Solvent Extraction/Soil Washing Mechanical Aeration
Separation Technologies Drying Beds Filtration Pressure Filtration Classification Screens and Sieves Classifiers Powdered Activated Carbon or Resin Addition Evaporation Solvent Extraction/Soil Washing Mechanical Aeration	

TABLE 7 (Continued)

Remedial Technologies Applicable for Consideration for Source Control	Remedial Technologies Technically Feasible for Source Control
Detoxification Technologies	Detoxification Technologies
Anaerobic Digestion	Composting
Composting	Rotary Kiln/Cement Kiln Incineration
Landfarming	High Temperature Fluid Wall
Enzymatic Degradation	Infrared Incineration
Oxidation	
Reduction	
Dechlorination	
Neutralization	
Hydrolysis (base-catalyzed)	
Rotary Kiln/Cement Kiln Incineration	
Multiple Hearth Incineration	
High Temperature Fluid Wall	
Infrared Incineration	
ONSITE DISPOSAL	ONSITE DISPOSAL
RCRA Landfill	RCRA Landfill
Return to Excavation	Return to Excavation
OFFSITE TREATMENT	OFFSITE TREATMENT
RCRA Hazardous Waste Treatment, Storage, and Disposal Facility	RCRA Hazardous Waste Treatment, Storage, and Disposal Facility
Stabilization/Fixation	Stabilization/Fixation
Incineration	Incineration
OFFSITE DISPOSAL	OFFSITE DISPOSAL
RCRA Landfill	RCRA Landfill

TABLE 3

REMEDIAL TECHNOLOGY TECHNICAL SCREENING
FOR MANAGEMENT OF MIGRATION

Remedial Technologies Applicable for Consideration for Management of Migration	Remedial Technologies Technically Feasible For Management of Migration
NO ACTION	NO ACTION
Monitoring	Monitoring
CONTAINMENT	CONTAINMENT
Slurry Walls Grout Walls Sheet Piling Block Displacement Bottom Seal Grouting	
DIVERSION	DIVERSION
Slurry Walls Grout Walls Sheet Piling Groundwater Interceptor Trench	
COLLECTION	COLLECTION
Groundwater Interceptor Trench Collector Wells	Groundwater Interceptor Trench
INSITU TREATMENT	INSITU TREATMENT
Treatment Technologies (Biological, Chemical, Physical)	Treatment Technologies (Biological, Chemical, Physical)
Separation Technologies Precipitation/Coagulation/ Flocculation Carbon Adsorption Permeable Bed Treatment	Detoxification Technologies Aerobic Biodegradation
Detoxification Technologies Aerobic Biodegradation Anaerobic Digestion Oxidation Reduction Neutralization Hydrolysis (base-catalyzed) Electrolysis	

TABLE 6 (Continued)

Remedial Technologies Application for Consideration for Management of Migration	Remedial Technologies Technically Feasible for Management of Migration
ONSITE TREATMENT (Cont.)	
High Rate	Rotating Biologigcal Disc
Extended Aeration	
High Purity Oxygen	Recirculation Systems
Sequencing Batch	
PACT	
Rotating Biological Disc	
Landfarming/Spray Irrigation	
Recirculation Systems	
Enzymatic Degradation	
Oxidation	
Ultraviolet/Ozonation	
Reduction	
Neutralization	
Hydrolysis	
Electrolysis	
Wet Air Oxidation	
Supercritical Water	
ONSITE DISPOSAL	ONSITE DISPOSAL
NPDES Discharge to Surface Water	NPDES Discharge to Surface Water
Spray Application/Trenching	Groundwater Interceptor Trench/ Seepage Basins and Ditches
Groundwater Interceptor Trench/ Seepage Basins and Ditches	
Reinjection Wells	
OFFSITE TREATMENT	OFFSITE TREATMENT
Municipal Wastewater Treatment Facility	Municipal Wastewater Treatment Facility
RCRA Hazardous Waste Treatment, Storage, and Disposal Facility	RCRA Hazardous Waste Treatment, Storage, and Disposal Facility
Resource Recovery	Resource Recovery
Biodegradation	Biodegradation
Chemical Treatment	Chemical Treatment
OFFSITE DISPOSAL	OFFSITE DISPOSAL
NPDES Discharge to Surface Water	NPDES Discharge to Surface Water
Deep Well Injection	

TABLE 8 (Continued)

Remedial Technologies Application for Consideration for Management of Migration	Remedial Technologies Technically Feasible for Management of Migration
REMOVAL (PUMPING)	REMOVAL (PUMPING)
Injection/Extraction Wells	Injection/Extraction Wells
Groundwater Interceptor Trench	Groundwater Interceptor Trench
ONSITE STORAGE	ONSITE STORAGE
Tank/Drum Storage	Tank/Drum Storage
Surface Impoundment	
ONSITE TREATMENT	ONSITE TREATMENT
Treatment Technologies (Biological, Chemical, Physical)	Treatment Technologies (Biological, Chemical, Physical)
Separation Technologies	Separation Technologies
Precipitation/Coagulation/ Flocculation	Precipitation/Coagulation/ Flocculation
Sedimentation/Clarification/ Gravity Thickening	Sedimentation/Clarification/ Gravity Thickening
Centrifugation	Granular Filtration
Filtration	Carbon Adsorption
Granular Filtration	Vapor and Liquid Phase
Carbon Adsorption	Air Stripping
Vapor and Liquid Phase Contactors	Steam Stripping
Powdered Activated Carbon Addition	
Ion Exchange	Detoxification Technologies
Sorptive Resins	Activated Sludge Reactors
Air Stripping	Extended Aeration
Steam Stripping	Sequencing Batch
Distillation	
Dissolved Air Flotation	
Freeze Crystallization	
Solvent Extraction	
Coalescers	
Mechanical Aeration	
Reverse Osmosis	
Ultrafiltration	
Electrodialysis	
Detoxification Technologies	
Aerated Lagoons/Ponds	
Activated Sludge Reactors	
Conventional	
Step Aeration	
Contact Stabilization	

Development of Alternatives and Initial Screening of Alternatives

Alternatives developed and considered for initial screening at the Tinkham site are:

Source Control

SC-1 No Action (with fencing)

SC-2 Capping

- SC-2A Permeable Cap
- SC-2B Surficial Stabilization
- SC-2C RCRA Multilayered Cap

SC-3 Insitu Treatment

- SC-3A Insitu Aeration
- SC-3B Soil Flushing

SC-4 Onsite Treatment

- SC-4A Aeration
- SC-4B Soil Washing
- SC-4C Composting
- SC-4D Incineration

SC-5 Onsite RCRA Landfill

SC-6 Offsite Incineration

SC-7 Offsite RCRA Landfill

Management of Migration

MOM-1 No Action (with monitoring)

MOM-2 Insitu Biological Treatment

MOM-3 Onsite Treatment

- MOM-3A Air Stripping/Filtration/Carbon Adsorption (Discharge to stream)
- MOM-3B Air Stripping/Filtration/Carbon Adsorption (Discharge to groundwater)
- MOM-3C Steam Stripping (Discharge to stream)
- MOM-3D Air Stripping/Biodegradation/Filtration/Carbon Adsorption (Discharge to groundwater)

MOM-4 Offsite Treatment

MOM-4A Offsite Treatment at RCRA TSD Facility

MOM-4B Offsite Treatment at POTW (with Onsite Air Stripping)

Section 300.68(f)(1) of the NCP requires that to the extent that it is both possible and appropriate, at least one remedial alternative shall be developed as part of the Feasibility Study in each of the following categories:

- Alternatives for treatment or disposal at an offsite facility as appropriate.
- Alternatives that attain applicable or relevant and appropriate Federal public health and environmental requirements.
- As appropriate, alternatives that exceed applicable or relevant and appropriate Federal public health and environmental requirements.
- As appropriate, alternatives that do not attain applicable or relevant and appropriate Federal public health and environmental requirements but will reduce the likelihood of present or future threat from hazardous substances and that provide significant protection to public health and welfare and the environment. This must include an alternative that closely approaches the level of protection provided by applicable or relevant and appropriate requirements.
- No action alternative.

The source control alternatives which fall under the category of disposal at an offsite facility as appropriate are:

- Disposal at an offsite site incineration facility (SC-6)
- Disposal at an offsite landfill facility (SC-7)

The source control alternatives which fall under the category of attaining applicable or relevant and appropriate requirements are:

- Onsite treatment of contaminated soils (SC-4)
- Disposal at an offsite incineration facility (SC-6)
- Disposal at an offsite landfill facility (SC-7)

The source control alternative which falls under the category of exceeding the applicable or relevant and appropriate requirements is:

- Disposal at an offsite incineration facility (SC-6)

The source control alternatives which falls under the catetory of not attaining applicable or relevant and appropriate requirements are:

° Permeable capping or RCRA multi-layered cap (SC-2)

The source control alternative which falls under the category of no action is SC-1.

The management of migration alternative which falls under the category of disposal at an offsite facility is:

° Treatment at an offsite facility (MOM-4)

The Management of Migration alternatives which fall under the category of attaining applicable or relevant and appropriate requirements are:

° Treatment at an offsite facility (MOM-4)
° Removal/extraction, soil flushing and onsite treatment (MOM-3)

The management of migration alternative which falls under the category of not attaining applicable or relevant and appropriate requirements is:

° insitu biological treatment (MOM-2)

The management of migration alternative which falls under the category of Non-action is MOM-1.

Consistent with screening criteria 300.68 (g)(1),(2)and(3) of the NCP, and as described in detail in Section 4 of the FS, the initial screening process eliminated the following alternatives:

Source Control

SC-2 Capping

SC-2A Permeable Cap
SC-2B Surficial Stabilization
SC-2C RCRA Multilayered Cap

- 300.68 (g)(1); No substantially greater public health and environmental benefits than the Non-action alternative with greater costs

- 300.68 (g)(2); does not meet acceptable engineering practices for reliability based on site characteristics

SC-3 Insitu Treatment

SC-3A insitu aeration

- 300.68 (g)(3); adverse environmental impacts

- 300.68 (g)(2); technically ineffective and not feasible based on site characteristics

SC-4 Onsite Treatment

SC-4D Onsite incineration

- 300.68 (g)(1); no substantially greater public health and environmental benefits with significantly greater costs than other onsite treatment alternatives

SC-5 Onsite RCRA Landfill

- 300.68 (g)(3); adverse environmental impacts

- 300.68 (g)(2); does not meet acceptable engineering practices for reliability and is not feasible based on site characteristics

Management of Migration

MOM-2 Insitu Biological Treatment

- 300.68 (g)(2); does not meet acceptable engineering practices for reliability and is not feasible based on site characteristics

- 300.68 (g)(3); questionable effectiveness

- 300.68 (g)(1); no substantially greater public health and environmental benefits than the no action alternative at a greater cost

MOM-3 Onsite Treatment

MOM-3C Steam Stripping (Discharge to stream)

- 300.68 (g)(1); no substantially greater public health and environmental benefits at a greater cost than other onsite treatment

MOM-3D Air Stripping/Biodegradation/Filtration/Carbon Absorption (Discharge to groundwater)

- 300.68 (g)(1); no substantially greater public health or environmental benefits at a greater cost than other onsite treatment

MOM-4 Offsite Treatment

MOM-4A RCRA TSD Facility

- 300.68 (g)(1); no substantially greater public health or environmental benefits with greater costs

Summary comparison screening for source control and management of migration remedial alternatives can be seen on tables 9 and 10 respectively.

The no action alternative for both source control and management of migration is carried into the detailed analysis to provide a basis for comparison to the other alternatives as stipulated in the NCP.

Tables 11 and 12 summarize the alternatives that were carried into the detailed analysis of alternatives.

Detailed Analysis of Alternatives

The alternatives evaluated during detailed review and screening include both source control and management of migration alternatives. (Alternatives are re-numbered for simplicity).

Source Control

SC-1 No Action

SC-2A Aeration

SC-2B Soil Washing

SC-2C Composting

SC-3 Offsite Incineration

SC-4 Offsite RCRA Landfill

Management of Migration

MOM-1 No Action

MOM-2A Air Stripping/Filtration/Carbon Absorption (Discharge to Stream)

MOM-2B Air Stripping/Filtration/Carbon Absorption (Discharge to Groundwater)

MOM-3 POTW with Air Stripping

Source control and management of migration remedial alternatives are summarized and evaluated in tables 13 and 14. Refer to section 4 of the Feasibilty Study for an indepth review of the detailed analysis for each alternative.

TABLE 9

COMPARISON SCREENING FOR SOURCE CONTROL REMEDIAL ALTERNATIVES
TINKHAM GARAGE SITE

REMEDIAL ALTERNATIVE	COSTS	ENVIRONMENTAL AND PUBLIC HEALTH CONSIDERATIONS	COMPARISON RESULTS
SC-1			
No-Action (with fencing)	$40,000 capital $1,000 O&M (30 yrs)	1. Eliminate access to contaminated soil source areas by fencing 2. Allows continued release of contaminants from soil source areas to the groundwater, prolongs period of poor groundwater. 3. Restricts future use of site in vicinity of soil source areas	This alternative has been retained for detailed development to provide a basis for comparison to other alternatives as stipulated in the NCP.
SC-2			
Capping			
A. Permeable Cap	A. $158,000 capital $19,300 O&M (30 yrs)	1. As above, via capping and fencing 2. As above, especially via fluctuating water table	Alternatives SC-2A through SC-2C have been screened out because they have order of magnitude higher costs and do not provide greater environmental and public health protection than SC-1. The fluctuating high water table contacting the contaminated soil near the surface makes the elimination of infiltration from precipitation less of a benefit than would ordinarily result. Pumping test data indicates that drawdown in the overburden may be minimal which would not allow this alternative to be effectively combined with a groundwater pumping scheme.
B. Surficial Stabilization	B. $7,600-$126,000 capital $19,300 O&M (30 yrs)	3. As above	
C. RCRA Multi-layered Cap	C. $622,000 capital $26,400 O&M (30 yrs)	4. Reduction or prevention of infiltration into soil source areas resulting in groundwater contamination (for SC-2B and SC-2C only)	
SC-3			
Insitu Treatment			
A. Insitu Aeration	A. $420,000 capital $55,000 O&M (5 yrs)	1. As above 5. Reduction or elimination of contaminants in soil source areas resulting in an acceleration of groundwater clean up due to reduction in leaching of contaminants to groundwater	Remedial alternative SC-3A has been screened out due to adverse environmental impacts and the site conditions that limits its effectiveness. The high water table could cause operational shutdowns of the treatment system, and there would be difficulty in controlling air emissions.

TABLE 9 (continued)

COMPARISON SCREENING FOR SOURCE CONTROL REMEDIAL ALTERNATIVES
TINGHAM GARAGE SITE

REMEDIAL ALTERNATIVE	COSTS*	ENVIRONMENTAL AND PUBLIC HEALTH CONSIDERATIONS	COMPARISON RESULTS
		6. Unimpeded future use of site 7. Metamorphis of hazardous nature of soil source areas without problems associated with excavation/removal	Remedial alternative SC-3B would work best when coupled with a groundwater of treatment alternative. Management of migration alternatives MM-2A and 2B include collection and treatment of groundwater followed by recharge back to the ground as a disposal method of treated water. They are therefore appropriate alternatives in which to address soil flushing.
B. Soil Flushing	$1,200,000 capital $150,000 O&M (5 yrs)	8. Eliminates risk from spills associated with transport of contaminated soils 9. Mitigates potential for offsite migration of soils and contaminated groundwater after treatment is completed 10. Potential release of air emmissions due to treatment process (SC-3A only) 11. Potential increase of contaminants entering groundwater during short-term, possible impacts off-site depending on groundwater treatment system (SC-3B only) 12. Generation of residuals after treatment requiring handling or disposal 13. Treatment will not remove PCBs or extractable organics 15. Offers a permanent solution	
SC-4			
Onsite Treatment (excavation)		1. As above 6. As above 8. As above 9. As above 10. As above 14. Potential for releases associated with excavation i.e. dust generation, volatilization of contaminants, soil erosion resulting in surface water impacts to wetlands 12. As above 13. As above for (SC-4A only)	Remedial alternatives SC-4A through SC-4C were retained for detailed development since they have the same order of magnitude costs and environmental benefits for the treatment of organic contaminated soils. SC-4D was screened out. Its costs are an order of magnitude greater than those of SC-4A through SC-4C (when you add O&M costs to capital costs) and it does not provide significantly greater environmental benefits. SC-4-A-6 should be selected before D if treatability study data substantiates an adequate performance of these. They are considered to be more cost effective than the incineration of moderately contaminated soils.
A. Onsite Aeration	A. $2,500,000 capital $700,000 O&M (2 yrs)		
B. Composting	B. $3,800,000 capital $300,000 O&M (3 yrs)		
C. Soil Washing	C. $3,400,000 capital $450,000 O&M (3 yrs)		

TABLE 9 (continued)

COMPARISON SCREENING FOR SOURCE CONTROL REMEDIAL ALTERNATIVES
TINKHAM GARAGE SITE

REMEDIAL ALTERNATIVE	COSTS*	ENVIRONMENTAL AND PUBLIC HEALTH CONSIDERATIONS	COMPARISON RESULTS
D. Onsite Incineration	D. $9,300,000 capital $4,600 O&M (2 yrs)	15. Visual impacts of the treatment operations on the neighborhood	
SC-5 Onsite RCRA Landfill	$940,000 capital $30,000 O&M (30 yrs)	1. As above 7. As above 10. As above 11. As above 14. As above 16. Restricted use of the site due to presence of the landfill	This remedial alternative has been screened out due to adverse environmental impacts associated with conditions which would limit effectiveness. There are difficulties associated with constructing and operating an onsite landfill due to the high water table found onsite. There is concern over the potential for the liner to fail whereby groundwater contamination would result.
SC-6 Offsite Incineration	$24,000,000	1. As above 7. As above 10. As above 14. As above 17. Potential for releases and safety problems due to extensive handling and transportation	This remedial alternative has been retained since it provides more environmental benefit than an offsite landfill.
SC-7 Offsite RCRA Landfill	$7,300,000	1. As above 7. As above 10. As above 14. As above	This response has been retained since it is a useful comparison to offsite incineration. It would be

TABLE 9 (continued)

COMPARISON SCREENING FOR SOURCE CONTROL REMEDIAL ALTERNATIVES
TINKHAM GARAGE SITE

REMEDIAL ALTERNATIVE	COSTS*	ENVIRONMENTAL AND PUBLIC HEALTH CONSIDERATIONS	COMPARISON RESULTS
		17. As above	It would be expected to provide acceptable impacts than onsite landfilling due to better site conditions (low permeability soils, low water table elevation).

* O&M costs given are annual costs (no present worth analysis was performed). In addition these costs are plus 100% minus 50%. The costs are based on removal of Leachfields I/J, K/L, M/N and G, soil pile, swale and 6,500 cubic yards in the garage area.

All costs would be expected to increase accordingly with additional volume.

TABLE 10

COMPARISON SCREENING FOR MANAGEMENT OF MIGRATION REMEDIAL ALTERNATIVES
TINKHAM GARAGE SITE

RESIDENTIAL ALTERNATIVE	COSTS*	ENVIRONMENTAL CONSIDERATIONS	COMPARISON RESULTS
MOM-1			
No-Action	$30,000 capital $241,000 O&M (1-4 yrs) $60,000 O&M (5-30 yrs)	1. Groundwater will clean up with time as a result of natural processes 2. Present threat negated due to installation of a water line 3. Includes monitoring to detect offsite contamination that could threaten other nearby residential areas (i.e. Ross Drive) 4. Requires institutional controls restricting the use of the aquifer 5. Does not offer a permanent solution such as treatment	This alternative may be viable for this site and has been retained for detailed development to provide a basis for comparison to other alternatives as stipulated in the NCP.
MOM-2			
Insitu Biological Treatment	$250,000 capital $360,000 O&M (5 yrs)	3. As above 4. As above 6. May accelerate the cleanup of groundwater 4. As above 7. Does not actively control groundwater contamination, continued discharge and migration of contaminants 8. Uncertainty involved in area extent of treatment effectiveness 9. Will not breakdown all compounds present (PCBs and some extractables will not be affected)	This alternative has been screened out. Although this alternative is not a proven technology it has shown promise as a passive treatment system. However, the time required to attain targeted levels may approach that of the no-action alternative. (Considering that naturally occurring processes have already reduced contaminant levels.)
MOM-3			
Onsite Treatment			
A. Air Stripping Filtration/Carbon Absorption (Discharge to stream)	A. $2,040,000 capital $560,000 O&M (5 yrs)	3. As above 4. As above 6. As above 10. Does not restrict future use controls 11. Construction of facility may or may require instrumentation	Alternative MOM-3D has been screened out by comparison with MOM-3B. Though the costs are the same order of magnitude. The cost of biodegradation is expected to increase the cost. Also, those for MOM-3B are expected to decrease as the concentrations in the

TABLE 10 (continued)

COMPARISON SCREENING FOR MANAGEMENT OF MIGRATION REMEDIAL ALTERNATIVES
TINKHAM GARAGE SITE

RESIDENTIAL ALTERNATIVE	COSTS*	ENVIRONMENTAL CONSIDERATIONS	COMPARISON RESULTS
B. Air Stripping Filtration/Carbon Adsorption (discharge to groundwater)	B. $2,340,000 capital $530,000 O&M (5 yrs)	Create negative visual impacts	Groundwater decrease whereas those for biodegradation are not. Therefore, for similar environmental benefits, the costs for MOM-3B will always be less than MOM-3D and it will not be as sensitive to effluent concentrations.
C. Steam Stripping (discharge to stream)	C. $2,300,000 capital $520,000 O&M (5 yrs)		MOM-3C has been screened out by comparison with MOM-3A. Again, though the costs are the same order of magnitude, there is no question that MOM-3A is less expensive than MOM-3C, even given the uncertainties involved in the costs for each. The benefits associated with each are considered similar.
D. Air Stripping Biodegration/ Filtration/Carbon Adsorption (discharge to groundwater)	D. $2,900,000 capital $560,000 O&M (5 yrs)		
MOM-4			
Offsite Treatment			
A. TSD Facility	A. $1,500,000 capital $10,600,000 O&M (5 yrs)[1]	3. As Above 4. As above 6. As above	MOM-4A has been screened out since the cost is an order of magnitude, i.e. 10 times, that of MOM-4B with the same environmental benefits.
B. POTW with Onsite Air Stripping	B. $2,100,000 capital $540,000 O&M	10. As above 11. Potential for spills during transport via trucking or in sewer line	

[1] O&M costs are user fees or tipping fees for disposal of contaminated groundwater which will be incurred over the life of the removal scheme.

*O&M costs given are annual costs (no present analysis was performed).

TABLE 11

SUMMARY OF SOURCE CONTROL ALTERNATIVE SCREENING

TINKHAM GARAGE SITE

Alternatives Screened in this Section	Alternatives Retained for Detailed Development
SC-1 No Action	SC-1 No Action
SC-2 Capping	
SC-2A Permeable Cap	
SC-2C Surficial Stabilization	
SC-2B RCRA Multilayered Cap	
SC-3 Insitu Treatment	
SC-3A Insitu Aeration	
SC-3B Soil Flushing*	
SC-4 Onsite Treatment	SC-4 Onsite Treatment
SC-4A Aeration	SC-4A Aeration
SC-4B Soil Washing	SC-4B Soil Washing
SC-4C Composting	SC-4C Composting
SC-4D Incineration	
SC-5 Onsite RCRA Landfill	
SC-6 Offsite Incineration	SC-6 Offsite Incineration
SC-7 Offsite RCRA Landfill	SC-7 Offsite RCRA Landfill

TABLE 12

SUMMARY OF MANAGEMENT OF MIGRATION ALTERNATIVE SCREENING

TINKHAM GARAGE SITE

Alternatives Screened in this Section	Alternatives Retained for Detailed Development
MOM-1 No Action (with monitoring)	MOM-1 No Action
MOM-2 Insitu Biological Treatment	
MOM-3 Onsite Treatment	MOM-3 Onsite Treatment
MOM-3A Air Stripping Filtration/ Carbon Adsorption (Discharge to stream)	MOM-3A Air Stripping Filtration/ Carbon Adsorption (Discharge to stream)
MOM-3B Air Stripping Filtration/ Carbon Adsorption (Discharge to groundwater)	MOM-3B Air Stripping Filtration/ Carbon Adsorption (Discharge to groundwater)
MOM-3C Stream Stripping (Discharge to stream)	
MOM-3D Air Stripping Biodegradation/ /Filtration/Carbon Adsorption (Discharge to groundwater)	
MOM-4 Offsite Treatment	MOM-4 Offsite Treatment
MOM-4A Offsite Treatment at RCRA TSD Facility	MOM-4B POTW with Onsite Air Stripping
MOM-4B Offsite Treatment at POTW with Onsite Air Stripping	

* Both, MOM-3A and MOM-3B include soil flushing. Soil flushing would be used to augment natural flushing mechanisms during low water table periods.

TABLE 13

SUMMARY ANALYSIS OF SOURCE CONTROL REMEDIAL ALTERNATIVES

REMEDIAL ALTERNATIVE	TECHNICAL	INSTITUTIONAL	ENVIRONMENTAL & PUBLIC HEALTH
SC-1 No Action	Medium o Contaminants can be isolated from the population eliminating the threat of direct contact. o Contaminants will continue to leach from soils into the groundwater.	Low o Does not comply with RCRA-40 CFR Part 264 Subparts G (closure and post closure), L (waste piles), and N (landfills); Executive Order 11990; and Fish and Wildlife Coordination Act.	Low o Improvements to biological environment will occur gradually. o Leaching of contaminants from soil into the groundwater will continue. o Future use of the soil source areas would be restricted.
SC-2 Excavation of Contaminated Soils with On-Site Treatment A. Aeration B. Composting C. Soil Washing	Medium o Treatment of soils removes threat. o Treatment technologies are still being developed for hazardous waste sites, and there could be difficulty during implementation.	High o Will comply with RCRA 40 CFR Part 264 Subparts G, L; N; Executive Order 1990, and the Fish and Wildlife Coordination Act.	High o Improvement to the biological environment will occur rapidly. o Eliminates leaching from contaminated soils into the groundwater. o Future use of soil source areas restored; eliminates the risk from contact with contaminated soils.
SC-3 Excavation of Contaminated Soils and Off-Site Incineration	High o Treatment of soils removes threat. o Technology has been used and demostrated at other hazardous waste sites.	High o Same as SC-2.	High o Same as SC-2. o Potential risk from transport of contaminated soils offsite.

TABLE 13 (Continued)

SUMMARY ANALYSIS OF SOURCE CONTROL REMEDIAL ALTERNATIVES

REMEDIAL ALTERNATIVE	TECHNICAL	INSTITUTIONAL	ENVIRONMENTAL & PUBLIC HEALTH
SC-4 Excavation of Contaminated Soils and Off-Site Disposal in a RCRA Landfill	Medium o Treatment of soils removes threat. o Technology has been demonstrated to work, but the potential for a leak in future is present.	High o Same as SC-2.	Medium o Same as SC-3. o Risk from potential for failure of offsite landfill.

TABLE 14

SUMMARY ANALYSIS OF MANAGEMENT OF MIGRATION REMEDIAL ALTERNATIVES

REMEDIAL ALTERNATIVE	TECHNICAL	INSTITUTIONAL	ENVIRONMENTAL & PUBLIC HEALTH
MOM-1 No Action	Medium o Costs are low. o Aquifer will eventually restore due to reduction via natural processes. o Potential threat to users of the aquifer who are not on the water line. o Construction and implementation are easily accomplished.	Low - o Does not comply with RCRA-40 CFR Part 264 Subpart F; Executive Order 11990; Groundwater Protection Strategy; and Fish & Wildlife Coordination.	Low-Medium o Improvement to the biological environment will be gradual. Future use of the aquifer will be restored. o No stress observed in wetlands. (Med) o Potential threat to users of the groundwater who are not on water line. (Low)
MOM-2 Removal/ Extraction (Soil-flushing) and OnSite Treatment A. Air Strip/ Carbon Discharge to Tributary B. Air Strip/ Carbon Discharge to Groundwater	Medium o Can intercept the contamination, but requires a complex treatment system. o Potential for frequent shutdown of treatment system due to maintenanced and servicing of equipment (i.e., cleaning and draining of sludge) o Continual monitoring required in residential wells and of the treatment process as well.	High o Will comply with RCRA 40 CFR Part 264, 262, 263 and Executive Order 11990; CWA Section 404; NPDES; Drinking Water Standards; Groundwater Protection Strategy; Fish and Wildlife Coordination Act.	High o Improvement to the biological environment will be rapid and future use of the aquifer can be restored. o Mitigates potential threat from contaminated groundwater to users not on the water line.

TABLE 14 (Continued)

SUMMARY ANALYSIS OF MANAGEMENT OF MIGRATION REMEDIAL ALTERNATIVES

REMEDIAL ALTERNATIVE	TECHNICAL	INSTITUTIONAL	ENVIRONMENTAL & PUBLIC HEALTH
MOM-3 Removal/ Extraction and Off-Site Treatment at a POTW with Onsite air stripping	Medium o Can intercept the contamination, but requires a pretreatment system. o Potential for shutdown of treatment system due to maintenance and servicing of equipment. o Continual monitoring required in residential wells and the treatment process as well.	High o Same as MOM-2 above. o Pretreatment permit. o Intra-municipal agreement needed between Derry and Londonderry.	o Same as MOM-2 above.

Consistent with the National Contingency Plan, the detailed analysis of alternatives addresses the technical feasibilty (300.68 (h)(2)(iii)), institutional requirements (300.68(h)(2)(iv)), public health and environmental impacts (300.68(h)(2)(iv)) and (300.68(h)(2)(vi)) of the remedial alternatives remaining. The feasibility study guidance manual was used for the detailed analysis of the alternatives and the manual incorporates the screening criteria of the National Contingency Plan 300.68(h)(2)(i-vi).

The detailed analysis of alternatives begins with a refinement and specification of the alternatives under consideration in accordance with 300.68(h)(2)(i). The alternatives were then evaluated in terms of their engineering implementation, reliability and constructability as indicated by 300.68(h)(2)(iii). This evaluation is referred to as the Technical Feasibility evaluation within the FS report and in summary Tables 13 and 14. Furthermore, an assessment of the extent to which the alternative is expected to effectively prevent, mitigate, or minimize threats to and provide adequate protection of public health and welfare and the environment was conducted. This included an evaluation of, and extent to which, each alternative attains or exceeds applicable or relevant and appropriate Federal public health and environmental requirements consistent with 300.68(h)(2)(iv). This analysis is referred to under the headings of Institutional Requirements and Public Health and Environmental Impacts within the FS report and in summary tables 13 and 14. Finally, a detailed cost analysis for each alternative was conducted including operation and maintenance costs and the distribution of costs over time, as indicated in 300.68(h)(2)(ii) of the NCP. This includes the total estimated costs for each of the six source control alternatives and four management of migration alternatives. The total cost given for each alternative represents a sum of the costs of the components which comprise that alternative and all associated indirect costs. Costs are within a +50, -30 percent accuracy range.

SC-1 No Action

No action for source control is limited to fencing those areas which present a significant direct contact/ingestion risk. No action also includes long term monitoring.

Leachfields - The No Action alternative for contaminated leaching fields of the Woodland Village Condominium Complex entails leaving this area as it presently exists; no fencing is proposed. The contaminants lie under the leachfields natural concrete cap and are covered with top soil. Contaminated media is virtually inaccessible to sensitive receptors such as small children and animals.

Swale - The No Action alternative for this source area may entail the construction and maintenance of a chain link fence with several strands of barbed wire at the top. The fencing must be of sufficient height and strength to deter people from climbing over or breaking through. To provide access to the soil source areas, locking gates will be required. Signs or placards may be placed at this soil source area, instructing unauthorized personnel to keep out. The swale area would require about 140 linear feet of fencing.

Soil Pile - The No Action Alternative for this source area is the same as described under Swale and would require about 180 linear feet of fence.

Field Southeast of the Tinkham Garage - The No Action alternative for this soil source area is the same as described under the Swale. This source area would require 1,100 linear feet of fence. The operation and maintenance of the fencing to ensure its integrity over the thirty year life of this alternative may entail fence repair. The implementability, reliability and constructability (300.68(h)(2)(iii) of the no-action alternative received a medium ranking for all of the source areas. The construction of a fence is very straightforward and requires only a short period of time to implement. However, it is not reliable in preventing contaminants from leaching through to groundwater.

The evaluation of the no-action alternative consistent with 300.68(h)(2)(iv) indicates it does not attain or exceed applicable or relevant and appropriate Federal public health and environmental requirements. Specifically, it does not comply with RCRA 40 CFR Part 264 which regulates the disposal of hazardous waste. The relevant and appropriate requirements for the soil pile are RCRA 40 CFR 264 Subpart L (Waste Piles), which states that waste piles can only be used for treatment or storage of wastes, not for disposal. The relevant and appropriate regulations for the leachfields, swale and field southeast of the garage are 40 CFR 264 Subpart N (Landfills) and 40 CFR 264 Subpart K (Surface Impoundments). In order to comply with RCRA, a permanent cap is required or all waste, residuals and contaminated subsoils must be removed or treated to levels that are protective of public health and the environment. Under RCRA part 264, no action would be viewed as disposal of contaminated soils in the soil pile, leachfields, swale and field areas without the required cap. In addition, the no action alternative is not protective of the wetlands onsite. The source area behind Tinkham's garage includes an existing portion of the wetlands as identified in figure 6. Any surficial transport via erosion would result in continued contamination of the sediments and surface water of the wetland in violation of Executive Order 11990.

Moreover, the no action alternative allows for the potential downward migration of contaminants from the soils into the groundwater, prolongs the poor quality of the groundwater

FIGURE 6

AREA OF CONTAMINATED WETLAND

and increases the potential for offsite migration to residential wells along Ross Drive. Prolonged leaching of soil contaminants into the Unnamed Tributary will increase the potential for exposure to the contaminants. The potential exposure to children is a concern as they are a sensitive population. Although fencing would be used to restrict access to the contaminated soil source areas (except the leachfield), the potential for wind and water erosion of the soils exists for the source area in the field behind the garage.

Under the no action alternative it will take a long period of time for the contaminants to reach acceptable levels in the soil if left untreated. Some of the contaminated soils include till layers containing fine-grained materials which have a lower hydraulic conductivity and less pore space than sand. This enables some organic compounds to adhere to the soils and be released slowly over time. Over the long term, improvements will occur as a result of naturally occurring processes such as biodegradation. In the interim, infiltration of precipitation and the rise and fall of the water table within the contaminated soils will generate leachate and thereby promote the continuing contamination of the underlying aquifer.

SC-2 Excavation of Contaminated Soil with Onsite Treatment (aeration, composting or soil washing)

The aeration (low temperature thermal stripping) system under consideration for the onsite treatment of contaminated soils at the Tinkham Garage site was developed by Roy F. Weston, Inc. for the U.S. Army Toxic and Hazardous Materials Agency for defense related facilities. The result of several pilot studies at heavily contaminated defense facilities have demonstrated greater than 99.99% removal of volatile organic compounds from contaminated soil. Some reduction of extractable organic contaminants is anticipated. Mechanical aeration is increasingly being used for the clean up of volatile organic contaminated soils at several industrial and defense sites. The McKin CERCLA site in Gray, Maine and the Triangle Chemical CERCLA site in Bridge City, Texas are successfully utilizing this process in pilot scale.

The composting option provides for the controlled reduction of the volatile organic compounds in soil source materials. Many of these compounds are expected to be reduced to very low levels in the soil mass through enhanced biodegradation and aeration. Composting is an established, effective process for a broad range of wastes including agricultural and sewage sludge. It holds promise for the removal of volatile and extractable organic compounds, such as the ones found at the Tinkham site.

The soil washing alternative involves mixture of contaminated soil with a leaching medium, and extraction of this medium with the associated contamination from the soil. It has been applied at a number of industrial sites throughout the country, and shows promise for contaminants and media similiar to those at the Tinkham site.

One of these three technologies would be chosen under SC-2. Pilot studies conducted during design phase will indicate the best technology for use. The three technologies are expected to have no substantial long-term and short-term environmental impacts that can not be effectively managed. As a result, the selection of the appropriate technology will be based on technical feasibility, reliability and cost-effectiveness.

Whichever treatment approach is selected, excavation of source areas down to the seasonal low water table will be required. Excavation removes the contaminated soils from the source areas to prevent the pollutants from being further released to the surrounding environment. Excavation of contaminated soils will be required from the field behind Tinkham's garage (10,800 yd^3), and potentially from the leach fields, soil pile and swale.

Treated soils will be placed back into the area from which they were excavated after treatment and these soils will be graded and revegetated.

Aeration, composting and soil washing are presently considered innovative or advanced technologies because of their lack of final field demonstration. The evaluation of these three in terms of engineering implementation, reliability and constructability (300.68(h)(2)(iii)), has revealed these alternatives to be technically sound, and they are expected to be appropriate to reliably minimize present or future threats to public health or welfare or the environment (300.68(h)(2)(v)). A medium ranking is indicated as a result of their innovativeness and the need for pilot studies prior to final implementation at the Tinkham site.

As mentioned above, the excavation of contaminated soils and onsite treatment by aeration (SC-2A), soil washing (SC-2B) or composting (SC-2C) will require the excavation of soils in the field southeast of the garage, including soils within an area designated as a wetland. The area that will be affected is relatively small (approximately 8,000 square feet). This alternative will be designed to be in compliance with Section 404 (Dredge and Fill of Wetlands) requirements. Best engineering practices will be implemented during excavation to minimize adverse impacts and restoration activities will be implemented to speed the natural recovery process of the wetland. This area is expected to recover quickly, from excavation and replacement.

The onsite treatment of contaminated soils will reduce contaminants in soils to levels protective of public health and welfare and the environment. The determination of the soil levels will be consistent with RCRA delisting requirements and guidance. After treatment to a level consistent with applicable RCRA provisions, the treated soils would be returned to the site(s) of excavation.

The evaluation according to 300.68(h)(2)(iv) of the NCP indicates that SC-2 complies with RCRA Part 264 Subparts G (Closure or Post Closure), L (Waste Piles) and K (Surface Impoundments).

The relevant RCRA regulations require the removal of waste and waste residues. The excavation criteria for the field and modeling work for the condominium areas will be consistent with the RCRA removal requirements. Also, since the removal of contaminated soils will reduce levels of contamination in the wetlands, this alternative will comply with Executive Order 11990 and with the Fish and Wildlife Coordination Act. The removal of contamination from the wetland is necessary to meet remedial objectives and be protective of public health. The removal of contamination does not permanently harm the wetland and is consistent with Executive Order 11990. The transport off site of any sludges or spent vapor phase carbon will be in compliance with appropriate RCRA Parts 262, 263 and DOT regulations 49 CFR-171-179.

Aeration transfers the contaminants to an air stream which then passes through a fume incinerator or afterburner. It is expected the burner will destory up to 99.99% of the contaminants at high temperatures. The resulting air stream will then be vented to a stack.

As proposed, aeration, composting and soil washing are all enclosed systems and air emissions will be controlled. The air stream generated from any of the three will pass through a vapor phase carbon unit for removal of hazardous organics and will meet applicable RCRA air emmission standards.

The excavation and treatment of the contaminated soils minimizes the potential exposure to local and transient populations from this media. Furthermore, the potential downward migration of contaminants from the leaching of contaminants in soil to the groundwater is mitigated.

Consistent with 300.68(h)(2)(vi) of the NCP, an analysis was conducted of any adverse environmental impacts, methods for mitigating them and the costs of mitigation. This analysis indicated the primary adverse effects that are possible from excavation and treatment of contaminated soils are:

1. Local and transient populations can be potentially exposed to releases in the form of fugitive dust and volatilization of contaminants which can occur during excavation.

2. Transient populations, specifically site workers, can potentially be exposed to contaminants during the handling and disposal of residuals generated during treatment.

3. There is exposure potential from onsite accidential spills and releases.

The magnitude of these risks is not anticipated to be great. These potential impacts will be effectively managed during implementation. The details of the air monitoring network and engineering controls to minimize or eliminate adverse effects from excavation will be developed during design. Cost estimates reflect anticipated control measures.

Consistent with 300.68(h)(2)(iv) of the NCP, the overall public health and environmental protection rating of this alternative is high. This is because the original risks and sources of exposure are removed, while the new sources of potential exposure created during excavation are comparatively minor and controllable.

The removal of the contaminated soils will result in an immediate improvement of the biological environment and human resource use of the site. The risk of direct contact and transport of contaminated soils onsite or offsite is minimized, as well as the potential for leaching of contaminants from the soil source areas into the groundwater. This will improve the water quality of the wetlands, the Unnamed Tributary and onsite groundwater.

The Agency has determined that the small portion (8,000 square feet), of the wetland located behind the garage which is contaminated will have to be excavated. This will result in a short-term adverse impact to the wetland. However, this impact is not considered significant and the wetland is expected to recover quickly.

Overall the rating for this alternative is high because improvement to the environment is rapid and potential human resource use is restored with only minor adverse effects during construction. Soil removal accelerates groundwater clean-up by reducing levels of the leachate from the contaminated soils in the unsaturated zone. Additionally, it eliminates the direct contact/ingestion risk from the field behind Tinkham's garage. SC-2 is expected to effectively minimize threats to, and provide adequate protection of, public health and welfare and the environment.

SC-3 Excavation of Contaminated Soils and Offsite Incineration

This remedial alternative centers on excavation of the contaminated soils similiar to SC-2 in the source areas and disposal of part or all of the exacavated materials to an offsite incinerator. The incinerator must be capable of accepting soil with PCBs in concentrations of less than 50 ppm and medium to low levels of volatile organic compounds. Incineration may destroy 99.99 percent of organic contaminants. In addition to these efforts, this remedial action incorporates refilling, site grading, and a vegetative cover of excavated areas.

Technically, the engineering implementation, reliability and constructability evaluation (300.68(h)(2)(iii)) ranked this alternative high. The reliability of incineration has been proven at other sites and excavated soils would be removed to an existing, permitted incineration facility.

The institutional evaluation of this alternative (300.68(h)(2)(iv) found this alternative to be in compliance with RCRA Part 264 Subparts G (Closure and Postclosure) and L (Waste Piles). The transport

and treatment of contaminated soils offsite to the incineration facility will comply with RCRA Parts 262, 263, 264 and DOT regulations 49 CFR Parts 171-179 and 387.

Executive Order 11990 and the Fish and Wildlife Coordination Act is complied with, since the treatment of contaminated soils will remediate the contamination occurring in the onsite wetland. This alternative also complies with guidance on the procedures for planning and implementation of offsite remedial activities set forth by EPA.

The beneficial and adverse impacts (300.68(h)(2)(vi)), for this alternative are the same as those discussed for source control alternative 2 (aeration, soil washing or composting). Additional benefits include the fact that there is no potential exposure to onsite residents due to air emissions or potential onsite spills during onsite treatment. However, there is an additional adverse effect. There is the potential exposure to the transient population (i.e., site workers), from extensive handling of soils during transport to the incinerator in addition to the adverse impacts cited under SC-2. These adverse impacts can be mitigated through the use of engineering and personnel protection controls.

This alternative has the same environmental benefits as described for source control alternative 2 (aeration, soil washing or composting). The adverse impacts are also the same, with the addition of potential hazards of spills and associated problems with the transport offsite of the contaminated soils.

Overall, this alternative was ranked high, and it is expected to effectively minimize threats to, and provide adequate protection of public health and welfare and the environment.

SC-4 Offsite RCRA Landfill

This remedial action alternative centers on excavation of the contaminated soils (similiar to SC-2), in the source areas and disposal of all the excavated material at an offsite landfill. The landfill must be capable of accepting soil with PCBs in concentrations less than 50 ppm and medium to low levels of volatile organics. In addition to these efforts, the remedial action incorporates refilling, site grading and vegetative cover to original site conditions.

Landfilling of contaminated soils has occurred in the past; however, EPA policy prefers destructive technologies where feasible. This technology has been demonstrated to work, but the potential for leaking in the future exists.

The evaluation of institutional requirements under 300.68(h)(2)(iv) of the NCP indicates SC-4 would be in compliance with RCRA Part 264 Subparts G (Closure and Postclosure), L (Waste Piles) and N (Landfills). The transport and disposal contaminated soils offsite to the landfill will comply with RCRA Parts

262, 263, 264 and DOT regulations 49 CFR Parts 171179 and 387.

Executive Order 11990 and the Fish and Wildlife Coordination Act are complied with, since the excavation of contaminated soils will remediate the contamination occurring in the onsite wetland.

The institutional ranking of this alternative is high since it is in compliance with Federal and State requirements, and adequately protects public health and welfare and the environment.

The transportation of excavated soils will be in compliance with local, state and federal regulations. All the materials are to be shipped with applicable permits.

This alternative has the same public health and welfare benefits as those described for SC-3. The adverse effects are also the same, with the addition of the potential failure of the offsite RCRA landfill, causing contamination of surface water and groundwater.

This alternative has the same environmental benefits as those described for SC-2 (aeration, soil washing or composting). The adverse impacts are also the same with the addition of the potential hazards from spills during transportation and for the offsite RCRA landfill to leak and contaminate surface water and/or groundwater.

The overall ranking of this alternative is medium. This is primarily because, although this technology has been demonstrated to work, the potential for leakage is present.

Detailed Cost Analysis for Source Control Alternatives

Consistent with 300.68(h)(2)(ii), detailed cost estimates (+50%, -30%), including operation and maintenance costs, capital costs and present worth, are presented for each source control alternative below (see section 4 of the Feasibility Study for detailed costing for each alternative).

Due to the technical difficulties in using groundwater models on this site to predict the migration of contaminants through the overburden and into the aquifer (2 till layers of decreasing permeability values and fractured bedrock), a sensitivity analysis of soil volume in the field behind the garage was performed (see table 15). EPA has determined that excavation

TABLE 15

Sensitivity Analysis of Soil Volume in
Field Behind Tinkham Garage

A. Capital Costs
($ x 1,000)

Contaminant Level (ppm) TVO	Soil Volume in field Behind Garage (yd^3)	SC-2A Aeration	SC-2B Soilwash	SC-2C Composting	SC-3 Incineration	SC-4 RCRA Landfill	*Risk Level in Field Behind Garage
100	930	510	750	910	150	150	1.9×10^{-4}
10	6,500	1,610	2,370	2,840	470	470	1.9×10^{-5}
1	10,800	2,170	3,190	3,820	630	630	1.9×10^{-6}

B. Operating and Maintenance Costs
($ x 1,000)

100	930	70	40	30	1,520	400	1.9×10^{-4}
10	6,509	480	290	210	10,620	2,830	1.9×10^{-5}
1	10,800	790	490	340	17,640	4,700	1.9×10^{-6}

C. Present Worth Costs
($ x 1,000)

100	930	630	820	960	1,670	550	1.9×10^{-4}
10	6,500	2,440	2,870	3,200	11,090	3,300	1.9×10^{-5}
1	10,800	3,540	4,040	4,410	18,270	5,330	1.9×10^{-6}

* Estimated risks were calculated for the ingestion of contaminated soils and based on the assumptions outlined in the NUS Endangerment Assessment prepared for the Tinkham Garage Site.

should proceed to a total volatile organic (TVO) target level of 1 ppm in contaminated soils from the field behind the garage. The 1 ppm of TVO corresponds to the lateral extent of contamination in surficial media. Vertically, excavation will proceed to the seasonal low water table. This corresponds to approximately 10,800 cubic yards of contaminated soil to be excavated. The 1 ppm boundary is believed to represent the approximate extent of detectable contamination.

The 1 ppm cleanup target level is considered appropriate for two reasons. First, at 100 ppm the ingestion risk associated with this area has been conservatively estimated to be 1.9×10^{-4}. This level is not considered appropriate to provide adequate protection of public health and welfare and the environment. At 10 ppm, the estimated lifetime cancer risk is 1.9×10^{-5} which falls within the target risk range for remediation. However, by removing contaminated soil to 1 ppm, it is expected that the groundwater remediation time will be reduced, in addition to providing greater protection to public health and welfare and the environment. Furthermore,the shorter time required for groundwater remediation is consistent with EPA's policy of implementing rapid cleanups of all current and potential drinking water. Finally, based on annual operation and maintenance costs associated with each management of migration alternative (see Table 16), this shortened groundwater treatment time is likely to result in a more cost-effective groundwater clean-up.

The need for excavation and treatment of the leachfields, the soil pile and the swale has yet to be determined. A significant direct contact/ ingestion risk is not attributed to each of these source areas. Excavation and treatment of contaminated soils will proceed based upon an evaluation of the potential for individual source areas to contribute to groundwater contamination. This will require the use of an analytical model capable of predicting the impacts of these individual source areas on groundwater quality. It is expected an analytical model can be utilized for the leachfield, swale and soil pile areas.

EPA will make the decision as to whether any or all of the individual leachfields and the soil pile and swale will require removal during the design phase of this project. For costing purposes, a cost analysis was performed for a number of possible scenarios of source area removal associated with all known or potential source areas associated with the Tinkhams site (see table 17).

Management of Migration Alternatives

MOM - 1 No Action (with monitoring)

This alternative involves a long-term monitoring effort to assess offsite migration of contaminants and any subsequent impacts which

TABLE 19

PRESENT WORTH ANALYSIS FOR MANAGEMENT OF MIGRATION ALTERNATIVES
($ x 1000)

	NO ACTION	MOM-2A AIR STRIPPING/ CARBON TREATMENT WITH SURFACE DISCHARGE	MOM-2B ADDITIONAL CARBON TREATMENT WITH GROUNDWATER DISCHARGE (SOIL FLUSHING)	MOM-3 PRETREATMENT WITH DISCHARGE TO POTW
CAPITAL COST	$30	$2,040	$2,400	$1,830
OPERATION & MAINTENANCE COSTS	241 (1-4 yrs) 60 (5-30)	560	600	540
YEARS OF OPERATION	30yrs	5yrs	5yrs	5yrs
PRESENT WORTH	1,140	4,160	4,670	3,870

* O&M costs are per year

TABLE 17

Cost Analysis for Soil Volume
Tinkham Garage Site

A. Capital Costs
($ x 1,000)

Description Source Area	Soil Volume (yd^3)	SC-2A Aeration	SC-2B Soilwash	SC-2C Composting	SC-3 Incinera-tion	SC-4 RCRA Landfill
A. Garage Area only	10,800	2,170	3,190	3,820	640	640
B. Garage Swale, Soil Pile with no leachfields	12,500	2,370	3,480	4,170	700	700
C. Garage Swale, Soil Pile with Leachfields I/J, K/L,G	19,300	3,070	4,490	5,390	900	900
D. Garage Swale, Soil Pile with Leachfields I/J, K/L, G, M/N	22,000	3,320	4,850	5,820	970	970
E. Garage Swale, Soil Pile with Leachfields I/J, K/L, G, M/N, A	23,100	3,420	4,990	5,900	1,000	1,000
F. Garage Swale, Soil Pile and all leachfields	30,800	4,050	5,920	7,110	1,180	1,180

TABLE 17 (Continued)

B. Operation and Maintenance Cost
($ x 1,000)

Description Source Area	Soil Volume (yd^3)	SC-2A Aeration	SC-2B Soilwash	SC-2C Composting	SC-3 Incinera-tion	SC-4 RCRA Landfill
A. Same as above	10,800	790	490	350	17,640	4,700
B. Same as above	12,500	920	570	400	20,420	5,440
C. Same as above	19,300	1,420	880	620	31,520	8,400
D. Same as above	22,000	1,610	1,000	700	35,930	9,580
E. Same as above	23,100	1,700	1,050	740	37,730	10,060
F. Same as above	30,800	2,260	1,400	990	50,310	13,410

C. Present Worth Costs
($ x 1,000)

A. Same as above	10,800	3,550	4,040	4,420	18,280	5,340
B. Same as above	12,500	3,960	4,460	4,860	21,110	11,480
C. Same as above	19,300	5,530	6,010	6,490	32,420	9,300
D. Same as above	22,000	6,110	6,580	7,050	36,900	10,550
E. Same as above	23,100	6,360	6,810	7,280	38,730	11,050
F. Same as above	30,800	7,970	8,340	8,820	51,490	14,590

may result. If adverse impacts occur, corrective action would need to be taken. Groundwater monitoring will entail evaluating background water quality and the water quality leaving the site.

Under the no-action response, two additional monitoring wells would need to be installed downgradient of FW-17 to monitor groundwater quality flowing offsite in the vicinity of the Unnamed Tributary. These wells will form a cluster with one well in overburden and one well in bedrock. Additionally, residential wells which continue to be used for drinking water purposes along Ross Drive, the Tinkham Realty Company and one private residence onsite to the immediate east of the realty company, will need to be monitored.

Sampling and analysis of all these wells would be conducted until the potential threat is eliminated (i.e. contaminants in groundwater meet the remedial objectives set forth). The sampling results will be evaluated in order to estimate plume migration and dispersion. Migration of contaminants into the Unnamed Tributary and/or Beaver Brook would also have to be monitored on a quarterly basis. Exact monitoring and sampling and analysis requirements will be determined during design.

In terms of the 300.68(h)(2)(iii) criteria, the reliability of the no action alternative is ranked medium. The operation and maintenance consists of monitoring to detect migration of contaminants away from the source areas as well as those migrating offsite. These activities will not be difficult to implement and are expected to provide reliable information concerning contaminant levels. The implementability and constructability of the no action alternative is high since the only construction involved is the drilling and installation of two wells.

The no action alternative entails allowing natural mechanisms to degrade or disperse the contaminants to below detectable or harmful levels over time. Several possible methods to estimate the natural reduction of groundwater contamination with time at this site have been attempted (see appendix C of the FS). Using

Using Wells FS-11 behind Tinkhams garage, downgradient of the source area, and ERT-06, located within the Woodland Village Condominium complex, natural attenuation has been estimated (through (through regression analysis of sampling data) to require 10 years and 18 years, respectively. If the removal and treatment of the source areas above the seasonal low water table are taken into consideration, these times will be reduced.

Considering the screening criteria under 300.68(h)(2)(iv) of the NCP, the no action (with monitoring) alternative does not comply with applicable or relevant and appropriate Federal public health and environmental requirements. Specifically, it is not in compliance with RCRA Part 264 Subpart F (Groundwater Protection), which

requires compliance with a groundwater protection standard. The Agency has determined that the proposed target levels for PCE and TCE are equivalent to setting the groundwater protection standards at Alternate Concentration Levels (ACLs). The no action alternative does not comply with the groundwater protection standard. Contaminants have already migrated downgradient or away from their point of disposal. Continued contaminant migration into the wetlands will result in this alternative being out of compliance with Executive Order 11990 and the Fish and Wildlife Coordination Act.

This alternative will not effectively prevent, mitigate, or minimize threats to and provide adequate protection of public health and welfare and the environment as evaluated under 300.68 (h)(2)(iv) and as required under 300.68(i) of the NCP.

The potential adverse effects from this alternative considerably outweigh the probable benefits. If left unremedied, the aquifer would remain unusable for a significant length of time. Worst case monitoring well data indicates a 10^{-2} cancer risk from the most contaminated wells onsite. In addition, the contaminated groundwater would continue to discharge to wetlands and surface water bodies. There are no benefits to local and transient populations with the no-action alternative.

In the long term, the level of contamination in the groundwater will decrease slowly. The primary long-term adverse effect is the potential offsite migration of contaminated groundwater to drinking water wells in use along Ross Drive. Additionally, the possibility of future development on site exists. Contaminated groundwater may be utilized for drinking water purposes if residential drinking water wells are installed unknowingly.

MOM - 2 Removal/Extraction and Soil Flushing with Onsite Treatment

MOM - 2A Air Stripping/Filtration/Carbon Adsorption with Discharge to Unnamed Tributary or Beaver Brook.

This remedial alternative entails extracting contaminated groundwater from both the overburden and bedrock aquifers, treating it onsite using air stripping, filtration and carbon adsorption and discharging it to the Unnamed Tributary onsite or to Beaver Brook offsite. Air stripping will be preceeded by aeration and coagulation/precipitation for metals removal and followed by neutralization. As evaluated under 300.68(h)(2)(iii), technically this alternative is considered to be constructable, implementable and reliable. It consists of unit treatment processes with proven performance records in the treatment of wastewater containing metals and organics. Aeration to oxidize metals has been used for years in municipal water treatment plants. Air stripping is a proven technology for removal of volatile organics and has been used at numerous hazardous waste remediation sites. With an air flow to water ratio of 150 to 1 (volume basis), removal of volatile organics in the 95 to 99 percen range are possible.

Table C-1, in Appendix C of the FS, shows that requirements for organic compounds are not overly restrictive and should be achievable by the combined use of air stripping and activated carbon.

Under the terms of 300.68(h)(2)(iv) of the NCP, this alternative. is expected to attain applicable or relevant and appropriate Federal public health and environmental requirements. Specifically, the treatment and control of contaminated groundwater satisfies RCRA Part 264 Subpart F (Groundwater Protection) and EPA's Groundwater Protection Strategy by cleaning-up the aquifer to the target levels in a reasonable time frame. The transport of spent carbon or sludges offsite complies with RCRA Parts 262 and 263 and DOT 49 CFR 171-179 and 387 for transport of hazardous material. The discharge from the air stripper will be designed to meet standards set by national Ambient Air Quality via vapor phase carbon adsorption. Additionally, discharge to the stream will be in compliance with National Pollution Discharge Elimination System requirements. The water discharged to the surface water would be required to meet the water criteria stated in the newest edition of the White Book (1985). The new criteria entails using water hardness calculations for setting limits. Hardness values of 20 ppm are used for the 1985 criteria.

MOM - 2B Air Stripping/Filtration/Carbon Adsorption with Discharge to the Groundwater

This alternative entails extracting contaminated groundwater from both the overburden and bedrock aquifers, treating it onsite using air stripping, filtration, and carbon adsorption and discharging it to the groundwater in the field behind the garage. This alternative is essentially the same as MOM-2A except that significantly more carbon will be used. (Refer to MOM-2A for a description of the groundwater removal scheme and subsequent treatment processes). Effluent criteria for discharge to the groundwater will need to meet MCLs for drinking water established by U.S. EPA because of the potential for contaminants to migrate to wells still in use for drinking water purposes. Drinking water regulations are more stringent than NPDES criteria for discharging into the Unnamed Tributary or Beaver Brook.

The evaluation in terms of engineering implementation reliability and constructability (300.68(h)(2)(iii)), indicates that this this alternative will utilize more carbon than in alternative MOM-2A to achieve an effluent which meets drinking water quality requirements. The reliability of alternative MOM-2B is as high as the MOM-2A alternative. The treatment effluent will be discharged to the ground using a recharge bed.

Applicable or relevant and appropriate Federal public health and environmental requirements as evaluated under 300.68(h)(2)(iv), indicate that this alternative attains RCRA Part 264 Subpart F (Groundwater Protection) and EPA's Groundwater Protection Strategy.

The transportation of spent carbon or sludges offsite will be designed to comply with RCRA Parts 262 and 263 and DOT 49 CFR 171-179 and 387 for transport of hazardous material. The discharge from the air stripper will be designed to meet applicable air standards.

With both MOM-2A and MOM-2B alternatives, the beneficial effects substantially outweigh the adverse effects as evaluated according to 300.68(h)(2)(vi). The short-term advantage is that the potential for the offsite migration of contaminated groundwater to the surrounding areas along Ross Drive is mitigated. The long-term benefits to the public health are twofold: (1) exposure from contaminated groundwater onsite is expected to reach an acceptable level within an estimated 5 years with treatment; and (2) as discharge to the wetlands and the Unnamed Tributary from contaminated groundwater is eliminated, the exposure potential to local, transient and distant populations will be measurably reduced.

There are no uncontrollable adverse effects from this alternative in either the short-term or the long-term, and therefore it was ranked high for mitigating public health impacts. With both alternatives, the contamination that is presently occurring in the wetlands and Unnamed Tributary will be minimized. The reduction of contamination in the groundwater to acceptable levels will occur relatively rapidly.

The extraction of groundwater and its potential impact on the wetlands will be monitored to ensure that no detrimental effects occur.

Since the treatment of volatile organic compounds emissions for the air stripper will be treated, the adverse impacts that could result from this are minimized. The discharge to the Unnamed Tributary as described under alternative MOM-2A will be set according NPDES requirements. If the treatment design selected is the one which includes discharge to the groundwater, as under alternative MOM-2B, the effluent will meet Drinking Water Standards.

MOM - 3 Offsite Treatment at POTW with Onsite Treatment

This alternative entails extracting contaminated groundwater from the overburden and bedrock aquifers, potentially pretreating it onsite with air stripping, and transporting it offsite via a pipeline to the local POTW (Derry Wastewater Treatment Plant) for final treatment. Air stripping may be preceded by aeration and coagulation/precipitation for metals and solids removal.

The treated effluent from the air stripping tower will be neutralized and passed through a flow meter/recorder and an automatic sampling device. The water will be sampled periodically to assure compliance with the Town of Derry treatment plant's pretreatment standards. (Flow will be discontinued if for any reason these

standards are not met). The effluent will then be collected in a sump, and pumped approximately one mile to the Derry, New Hampshire Wastewater Treatment Plant. A 4 inch force main will be required. (Domestic sewage will be mixed with the treated groundwater prior to the water entering the Derry POTW).

The pipeline can be laid along existing residential roadways for most of its 5,000 foot length. The pipe will cross Interstate Highway Route 93 by using one of two existing 24-inch sleeves under Route 93 adjacent to the treatment plant. The sleeves were installed at the time of highway construction and were intended for use by the town of Londonderry for a future sewer connection to the Derry treatment plant. The force main will then be connected to the headworks of the Derry treatment plant.

The Derry Wastewater Treatment Plant currently consists of a 1.2 million gallons per day (mgd) stabilization pond/aerated lagoon treatment facility, which discharges to the Merrimack River. Two new aerated lagoons and a grit chamber are presently under construction and will increase the total treatment capacity to 4.2 mgd by the spring of 1987.

Effluent standards for the discharge to the Derry Wastewater Treatment facility consist of the local industrial pretreatment standards established by the Town of Derry and approved by the EPA. These standards can be reviewed in table 18. In the event this permit is revised with more stringent pretreatment standards, any pretreatment of the effluent leaving the Tinkham site will be modified to meet the new requirements.

The extraction of groundwater and pretreatment envisioned under MOM-3 are proven technologies which were determined to be highly implementable, reliable and constructable as evaluated according to 300.68 (h)(2)(iii) of the NCP. The one technical concern associated with MOM-3, as well as MOM-2, is the potential for frequent shutdown of the treatment system for maintenance and servicing of equipment.

MOM-3 is expected to attain all applicable or appropriate and relevant Federal requirements thereby meeting the criterion of 300.68(h)(2)(iv). This alternative is in compliance with RCRA Parts 262, 263, and 264, specifically Subpart F (Groundwater Protection).

The effluent will meet the pretreatment guidelines set forth by the Town of Derry for discharge to the POTW. The cleanup of the groundwater is consistent with EPA's policy of seeking rapid cleanup of all current and potential drinking water where it is cost-effective.

MOM - 3 is expected to achieve the remedial objectives set forth at the Tinkham Garage site and effectively minimize threats to, and provide adequate protection of public health, welfare and the environment as evaluated under 300.68(h)(2)(iv) and is consistent with the criteria for Selection of Remedy under 300.68(i)(1). The short-

Table 1-

Pollutant Limitations for Discharge to the
Town of Derry, New Hampshire - WWTP

Cadmium	0.091	mg/l
Total Chromium	0.228	"
Copper	3.38	"
Lead	0.27	"
Nickel	0.12	"
Silver	0.072	"
Total Cyanide	0.324	"
Zinc	2.61	"
Arsenic	0.003	"
Iron	10.0	"
Sodium	500.0	"
Chlorides	500.0	"
Mercury	0.048	"
Manganese	10.0	"
Sulfate	20.0	"
Sulfide	20.0	"
Sulfite	2.0	"
Beryllium	0.008	"
Boron	2.0	"
Selenium	0.054	"
Phenols	0.324	"
Total Toxic Organics	5.0	"

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term public health benefit from this alternative is that the exposure potential from contaminants in the wetlands and the Unnamed Tributary will be rapidly reduced as further migration of contaminated groundwater to these areas is mitigated.

No short-term adverse effects are anticipated, but a long-term adverse impact is the possible breakage in the sewer line, extending from the site to the Derry POTW. Distant populations are in danger if this were to occur. However, the likelihood of this occurring is negligible because the best available engineering design and controls will be employed.

MOM-2A, MOM-2B and MOM-3

Implementation of MOM-2A, MOM-2B or MOM-3 will require groundwater to be extracted using two existing, deep (300 feet), bedrock wells already in place on site, LGAW and LGSW. Wells LGAW and LGSW are 6 inch diameter open rock boreholes. By pumping wells LGAW and LGSW, two northeast/southwest oriented troughs of depression will be created as previously described. This establishes control over the areas affected by contaminated groundwater. Submersible pumps will be used to extract the water from these wells for treatment. In addition, a collection trench will be installed downgradient of the source area in the field southeast of the Tinkham Garage. The trench will be approximately 300 feet long with a width of 4 feet and a depth to bedrock. Groundwater will be pumped from a gravel filled sump located in the lowest point of the trench. The estimated pumping rates for LGAW and LGSW and the trench to be constructed is 45gpm, 30gpm and 20gpm respectively. This corresponds to a total estimated volume of groundwater to be extracted of 100 gpm or 144,000 gpd. This volume will be adjusted during implementation to maximize efficiency and/or to minimize adverse environmental effects. The wetlands will be monitored throughout the groundwater extraction process. If adverse impacts on the wetland are observed, the pumping rate will be reduced.

Both, MOM-2 and MOM-3 will require a monitoring program to insure groundwater contamination control onsite and to insure contamination is not migrating offsite. Additionally, a two well cluster (overburden and bedrock), will be installed downgradient of FW-17 to monitor groundwater quality flowing offsite in the vicinity of the Unnamed Tributary. The exact extent of the contaminant plume south of FW-17 is not fully characterized at this time.

Residential wells in use along Ross Drive will be monitored until water quality objectives cited for groundwater are met onsite.

As specified under MOM-2A, MOM-2B and MOM-3, an estimated 5 years of groundwater treatment is anticipated. This is a conservative estimate used to cost each of these alternatives. The 5 year estimate was

based on the most conservative estimates for cleanup with no source control action and anticipating frequent shutdown of the system for maintenance and service. (Because all MOMs used the same assumptions about pumping and treatment rates, this estimate did not influence the selection of the appropriate management of migration alternative). With the removal and treatment of the the source areas above the seasonal low water table as specified, it is anticipated that treatment time will be reduced. For this reason contaminated groundwater will be monitored during the pumping and treating of groundwater according to the schedule to be worked out during design phase.

Treatment of groundwater will cease upon achieving 5 ppb of PCE and 5 ppb of TCE in each well on site. Overall risk factors will then be evaluated to ensure that adequate protection has been achieved. In any event, at the end of two years from the initiation of groundwater treatment, EPA will re-evaluate the groundwater remedial objectives to determine if they are achievable.

Costs for Management of Migration Alternatives

Capital, operation and maintenance and present worth costs for management of migration alternatives are summarized on Table 19. Detailed cost estimates are +50%, -30%. Supporting documentation is available in Section 4 of the FS.

Selection of Remedy

Section 300.68 (i) of the National Contingency Plan (NCP) states the appropriate extent of remedy shall be determined by the selection of a cost-effective (i.e. the lowest cost alternative that is technologically feasible and reliable) remedial alternative that effectively mitigates and minimizes threats to, and provides adequate protection of, public health and welfare and the environment. Consistent with the NCP, the following alternatives were not selected as an appropriate extent of remedy:

Source Control

SC-1 (no-action)

This alternative does not meet remedial objectives and does not attain or exceed applicable or relavent and appropriate Federal public health and environmental requirements. As such, it does not effectively mitigate and minimize threats to, and provide adequate protection of, public health and welfare and the environment. Under 300.68(i)(1) of the NCP, this alternative may not be selected.

SC-3 (Excavation of Contaminated Soils and Offsite Incineration)

This alternative exceeds applicable Federal public health and

TABLE 19

PRESENT WORTH ANALYSIS FOR MANAGEMENT OF MIGRATION ALTERNATIVES
($ x 1000)

	NO ACTION	MOM-2A AIR STRIPPING/ CARBON TREATMENT WITH SURFACE DISCHARGE	MOM-2B ADDITIONAL CARBON TREATMENT WITH GROUNDWATER DISCHARGE (SOIL FLUSHING)	MOM-3 PRETREATMENT WITH DISCHARGE TO POTW
CAPITAL COST	$30	$2,040	$2,400	$1,830
OPERATION & MAINTENANCE COSTS	241 (1-4 yrs) 60 (5-30)	560	600	540
YEARS OF OPERATION	30yrs	5yrs	5yrs	5yrs
PRESENT WORTH	1,140	4,160	4,670	3,870

* O&M costs are per year

environmental requirements. However, in comparing this alternative with SC-2 (Excavation of Contaminated Soils with Onsite Treatment) the public health and environmental benefits from the two alternatives are the same, but the cost of SC-2 is lower. Therefore, this alternative was eliminated under 300.68(i)(1) because it is not cost-effective in comparison to SC-2.

SC-4 (Excavation of Contaminated Soils and Offsite Disposal at a RCRA Landfill)

This alternative was ruled out due to reliability. The long term reliability of landfilling has not been proven. Additionally, the current Agency CERCLA policy is to select remedies that destroy wastes and waste residues in order to provide long term protection of public health and welfare and the environment. SC-4 would not be consistent with this policy.

Furthermore, CERCLA Section 101(24) prohibits remedial actions involving off-site storage, treatment, destruction or secure disposition, unless such actions are determined to be more costeffective than other remedial measures, to create new disposal capacity in compliance with Subtitle C of RCRA or to be necessary to protect public health welfare or the environment. SC-4 does not meet any of these criteria and therefore would not be an acceptable remedy under §101(24).

Management of Migration

MOM-1 (no-action)

This alternative does not attain or exceed applicable or relevant and appropriate Federal public health and environmental requirements. As such, it does not effectively mitigate and minimize threats to, and provide adequate protection of, public health and welfare and the environment. Under 300.68(i)(1) of the NCP, this alternative may not be selected.

MOM-2 (Removal/Extraction and Onsite Treatment)

MOM-2A (Discharge to Tributary)

MOM-2B (Discharge to Groundwater)

Both these alternatives were screened-out because of reliability and cost-effectiveness in comparison to MOM-3 (discharge to POTW). MOM-2A and 2B are both more costly than MOM-3, while not providing significantly more protection to public health and welfare and the environment. Additionally, MOM-3 is considered a more reliable alternative than either MOM-2A or 2B. The potential for frequent shutdown for maintenance and service of the onsite groundwater

treatment system exists for MOM-2A and 2B. MOM-3 will require less frequent shutdown of the onsite pretreatment system because the onsite pretreatment system (if implemented), is less complex. Treatment will be completed at the Town of Derry, New Hampshire POTW. Consistent with 300.68(i)(1) of the NCP, alternatives 2A and 2B were not selected.

RECOMMENDED ALTERNATIVE

Consistent with 300.68(i) of the NCP, the remedial objectives set forth, and based upon the evaluation of the RI, the alternatives set forth within the FS and public comment, EPA has determined, and the State of New Hampshire concurs, that the following alternatives be implemented:

SOURCE CONTROL

(SC-2) Excavation of Contaminated Soils with Onsite Treatment

This alternative is outlined in detail within the FS report and summarized within the Alternatives Evaluation Section of this document. The implementation of SC-2 will be as follows:

- Treatability Studies are to be performed for the proposed aeration, soil washing and composting technologies.

- approximately 10,800 yd^3 (29,160 ft^2 lateral extent) of contaminated soil located behind the Tinkham's garage is to be excavated and treated onsite by either aeration, soil washing or composting. Of the approximately 10,800 cubic yards to be excavated, approximately 2,960 yd^3 (8,000 ft^2 lateral extent) is located within the wetland in this area. During excavation of the wetland portion of this source area best engineering practices will be employed to minimize adverse impacts to the wetland. Additionally, upon completing soil excavation in the wetland, restoration activities will be implemented to speed recovery of this area.

- Signs will be posted in the field area behind the Tinkham's garage indicating this is a restricted area and a health hazard is present.

- removal of potential soil source areas in the Woodland Village Condominium complex (i.e., individual leachfields, soil pile and swale) will be determined based on sampling during the design phase. If contamination is documented in any of the individual potential source areas, the need for removal of the soils will be determined by its ability to contaminate groundwater above the 5 ppb concentration for PCE and TCE. Removal of a source area in the condominium complex will consist of its entire confined volume. If EPA determines that any of these potential source areas do not require remediation based on this criterion these areas will remain as they presently exist.

72

- Treated soils will be returned to the excavation locations to be graded and revegetated comparable to present site conditions. Leachfields excavated will be reconstructed to original design. Interim domestic sewage disposal measures will be provided if necessary during reconstruction.

Onsite soil treatment (aeration, soil washing or composting) will proceed to a level that will be determined after the pilot studies. This level will be based on technical feasibility, reliability and cost-effectiveness. The level will be determined consistent with the RCRA delisting procedures and the remedial objectives. At a minimum, soil will be treated to 1 ppm of Total Volatile Organic compounds to be consistent with the excavation criteria. It is anticipated that all three of the proposed treatment technologies have the potential to achieve this objective.

Selection of the specific technology (i.e. aeration, soil washing or composting)

MANAGEMENT of MIGRATION

(MOM-3) Removal/Extraction and Offsite Treatment at the Town of Derry POTW which may be preceeded by on-site pretreatment, with monitoring

- Removal of contaminated groundwater from the overburden and bedrock aquifers through the use of two bedrock wells (LGSW and LGAW), and a trench to be located behind Tinkham's garage.

- Extracted groundwater will be forwarded through the use of a pump station and force main to the Town of Derry POTW approximately 1 mile east of the site. Effluent discharged from the site may be preceded by onsite pretreatment. The need for pretreatment will be determined by EPA during design. This determination will be made to ensure that effluent discharged from the site will meet the local pretreatment regulations for the the Town of Derry, New Hampshire POTW. If pretreatment regulations are violated at anytime, effluent discharge from the site will be terminated until those regulations are met. Domestic sewage will be mixed with the effluent prior to it entering the Derry POTW.

- Groundwater extraction will proceed for a two year period from the date of implementation. At the end of the two year period an evaluation will be made by EPA to assess progress in meeting remedial objectives for the cleanup of groundwater at the site. If steady state conditions have been reached, and it is evident remedial objectives are not achievable, EPA will re-evaluate the objectives and its remedial approach to the Tinkham site.

- Groundwater remediation will cease upon achieving 5 ppb of PCE and 5 ppb TCE in every onsite well and in the trench proposed for construction behind Tinkham's garage. Upon ahcieving 5 ppb for PCE and TCE EPA will determine if water quality is protective of public health and welfare and the environment.

- Monitoring of wetlands onsite will be conducted to insure no detrimental impacts from the extraction of groundwater for treatment. If negative impacts are observed, the rate of groundwater removal will be decreased to the point wetlands onsite are not adversely impacted.

- Onsite and offsite monitoring will be implemented consistent with RCRA §264.100(d). Monitoring will require the installation of a two well cluster south of well FW-17 to fully characterize the extent of contamination.

71

OPERATION AND MAINTENANCE

Operation and maintenance costs (O&M) are those required to operate and maintain the remedial action throughout its lifetime. This activity ensures the lifetime effectiveness of the remedial alternatives selected.

A range of capital, O&M and present worth costs for SC-2, are detailed in table 20A, 20B and 20C.

The capital, O&M and present worth costs for MOM-3 specifically, are detailed in table 21.

State Role

The state's role in this federal lead site is multiple. The state reviews documents to determine if they are in compliance with applicable state laws and provides comments on all EPA funded studies at the site. The state of New Hampshire concurs with EPA's chosen remedy for the clean up of the Tinkham Garage Site, located in Londonderry, New Hampshire. The State of New Hampshire will provide:

- 10 percent of the capital costs of the chosen remedy (SC-2 and MOM-3).
- 10 percent of the operation and maintenance costs for SC-2 and MOM-3 throughout the remediation process.
- 10 percent of costs associated with the monitoring of residential wells in use on site and off site for the first year.
- 100 percent of costs associated with monitoring of residential wells in use on site and off site after one year.

TABLE 20A

Recommended Alternative Cost Summary

Source Control Alternative - Aeration

INITIAL CAPITAL COSTS

Excavation	$ 60,000
Material Handling/Preparation System	434,000
Pretreatment System	420,000
Aeration System	475,000
Post-treatment System	129,000
Site Work	94,000
Onsite Architectural and Electrical Work	266,000
Pilot Treatability Study	180,000
TOTAL INITIAL CAPITAL COST	$2,058,000

OPERATIONS AND MAINTENANCE (O&M) COST

On-site Treatment System	$ 648,000
Site Maintenance	90,000
Material Handling	56,000
Monitoring and Analysis	80,000
TOTAL ANNUAL O&M COSTS	$ 874,000
PRESENT WORTH O&M COSTS	$1,520,000
*TOTAL ALTERNATIVES COST	$3,578,000

*Based on 10,800 yd^3 of soil.

TABLE 20B

Recommended Alternative Cost Summary

Source Control Alternative - Soil Washing

INITIAL CAPITAL COSTS

Excavation	$ 60,000
Material Handling/Preparation System	434,000
Pretreatment System	420,000
Soil Washing System	502,000
Post Treatment System	629,000
Leachate Recovery System	440,000
Site Work	94,000
Onsite Architectural and Electrical Work	266,000
Pilot Treatability Study	260,000
TOTAL INITIAL CAPITAL COST	$3,105,000

OPERATIONS AND MAINTENANCE (O&M) COST

Onsite Treatment System	$ 340,000
Site Maintenance	80,000
Material Handling	72,000
Monitoring and Analysis	70,000
TOTAL ANNUAL O&M COSTS	$ 562,000
PRESENT WORK O&M COSTS	$ 978,000
*TOTAL ALTERNATIVE COST	$4,083,000

*Based on 10,800 yd^3 of soil.

TABLE 20C

Recommended Alternative Cost Summary

Source Control Alternative - Composting

INITIAL CAPITAL COSTS	
Excavation	$ 60,000
Material Handling/Preparation System	434,000
Pretreatment System	420,000
Compositing System	1,580,000
Post-treatment System	231,000
Site Work	162,000
Onsite Architectural and Electrical Work	216,000
Pilot Treatability Study	260,000
TOTAL INITIAL CAPITAL COST	$3,363,000
OPERATIONS AND MAINTENANCE (O&M) COST	
Onsite Treatment System	$ 196,000
Site Maintenance	50,000
Material Handling	112,000
Monitoring and Analysis	70,000
TOTAL ANNUAL O&M COSTS	$ 428,000
PRESENT WORTH O&M COSTS	$ 720,000
*TOTAL ALTERNATIVE COST	$4,083,000

*Based on 10,800 yd^3 of soil.

TABLE 21

Recommended Alternative Cost Summary

Management of Migration Alternate - Offsite Treatment at POTW with Onsite Air Stripping

INITIAL CAPITAL COSTS	
Groundwater Collection System	$ 108,000
Aeration System	164,000
Pretreatment System	330,000
Sludge Dewatering System	244,000
Access Road and Site Work	19,000
Onsite Architecture and Electrical Work	315,000
Groundwater Discharge System	135,000
Carbon Adsorption System	205,000
Pilot Treatability Study	100,000
Sewer Connection Fee	210,000
TOTAL INITIAL CAPITAL COST	$1,830,000
OPERATIONS AND MAINTENANCE (O&M) COST	
Onsite Treatment System	$ 296,000
Site Maintenance	41,000
Sludge Disposal	69,000
Effluent Disposal	84,000
Monitoring and Analysis	50,000
TOTAL ANNUAL O&M COSTS	$ 540,000
PRESENT WORTH O&M COSTS	$1,560,000
TOTAL ALTERNATIVES COST	$3,870,000

CONSISTENCY WITH OTHER ENVIRONMENTAL LAWS

Environmental Laws which are applicable or relevant and appropriate to the selected source control and management of migration alternatives at the Tinkham Garage site are:

- Resource Conservation and Recovery Act (RCRA)
- Clean Water Act
- Safe Drinking Water Act
- Clean Air Act
- Executive Order 11990 (Protection of Wetlands)
- Executive Order 11988 (Floodplain Management)

As specified within the Detailed Analysis of alternatives section, both SC-2 and MOM-3 are expected to fully comply with the above laws. The primary environmental law of concern at the Tinkham Garage site is the Resource Conservation and Recovery Act (RCRA), 42 USC. §6901, et seq. The proposed source control alternative (SC-2) was reviewed for consistency with applicable RCRA technical standards, 40 CFR § 264 Subpart G entitled Closure and Post-Closure, Subpart L entitled Waste Piles and Subpart N entitled Landfills.

The RCRA closure regulations require either closure by removal of waste, waste residues and contaminated subsoils, which is equivalent to closure as a surface impoundment or waste pile (40CFR 264 Subpart K, and L), or closure as a landfill by capping and appropriate post closure care (40 CFR 264 Subpart N). The source control remediation

will be equivalent to closure as a surface impoundment or waste pile. The selected soil treatment levels will be demonstrated to be technically equivalent to the RCRA delisting process. The pilot studies will determine achievable treatment levels that are capable of achieving the technical requirements of the RCRA delisting process.

The excavation criteria of 1 ppm for PCE and TCE has been determined to be consistent with the groundwater remediation and protective of public health and the environment. The 1 ppm boundary approximately delineates the extent of known contamination.

A groundwater monitoring program will be implemented to monitor water quality and verify the assumptions regarding the effect of any remaining contamination on groundwater quality.

Regarding management of migration measures, the relevant federal regulations are the RCRA Groundwater Protection requirements (40 CFR 264 Subpart F), the Clean Water Act and Safe Drinking Water Act. The groundwater protection regulations require the setting of groudwater protection standards which must be protective of public health and the environment. The target levels of PCE and TCE (5 ppb) are site specific levels that the Agency has determined will adequately protect public health and the envivonment. The remediation will attempted to achieve these levels at all wells on site.

A groundwater monitoring system will be implemented to determine the effectiveness of the groundwater recovery system.

The remediation of groundwater is consistent with the U.S. EPA Groundwater Protection Strategy (GWPS), which classifies the aquifer at Tinkham's as IIA (current usage by residents along Ross Drive) and requires the restoration of these aquifers. This remediation program would also be consistent with State of New Hampshire's groundwater protection rules.

The tie-in of pretreated groundwater will be in compliance with the applicable RCRA requirements. The POTW will receive pretreated groundwater through a sewer that also serves as a domestic sewer, so it will not be subject to the RCRA hazardous waste management requirements for treatment, storage and disposal facilities (TSDF's). The Clean Water Act sets forth the pretreatment requirements for the Derry POTW for effluent leaving the Tinkham site. Prior to the effluent leaving the Tinkham site it will be monitored to insure compliance with the applicable pretreatment standards.

Additionally, SC-2 specifies that of the 10,800 cubic yards of soil to be removed in the garage area, 2,960 cubic yards, corresponding to 8,000 square feet laterally is designated wetlands.

Consistent with Executive Order 11990, it is the determination of EPA that no practicable alternative exists to SC-2 that will effectively and reliably prevent, mitigate or minimize threats to, and provide adequate protection of public health and welfare and the environment, consistent with the remedial objectives set forth at the Tinkham site. In implementing SC-2 in the wetlands, all practicable measures to minimize harm to the wetlands which may result from the excavation will be utilized. Furthermore, upon completion of SC-2, restoration activities will be implemented to effectively and practicably minimize the length of the time required for this wetlands area fully recover.

The removal of contamination from the wetland and its subsequent restoration will result in the improvement of its beneficial value.

The Swale area identified for possible remediation and located within the Woodland Village Condominium complex exists within the 100 year flood plain associated with the Unnamed Tributary.

Executive Order 11988 requires Federal agencies to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains. The potential removal of the swale is not anticipated to have any detrimental impacts upon the floodplain.

*SCHEDULE

Sign Record of Decision	- September 29, 1986
Project design, to include treatability studies for SC-2, additional field work on leachfields, soil pile and swale and requirement for pretreatment	- November 1, 1986
Construction of on site soil treatment facility	- Fall 1987
Construction complete	- Summer 1988
Begin on site soil excavation and treatment and construction of onsite groundwater treatment facility and flow system to Derry POTW	- Winter 1988/1989
Begin groundwater extraction and treatment with discharge to Derry POTW	- Fall 1989
EPA evaluates grondwater treatment for consistency with remedial objectives	- Fall 1991

FUTURE ACTIONS

Future actions require several decisions and actions by the U.S. EPA.

First, EPA will decide upon the most appropriate technology (i.e. aeration, soil washing or composting) for source control. This will be based on pilot studies to be conducted during the design phase.

Second, EPA will decide upon the necessity of excavating and treating the potentially contaminated soils associated with the leachfields, the swale and the soil pile. This will be based on field work and modeling conducted during design.

Third, EPA will decide upon the necessity of onsite pretreatment prior to effluent being discharged from the Tinkham site to the Town of Derry, New Hampshire POTW.

Fourth, an additional future action will require a re-evaluation of groundwater remedial objectives by EPA. The re-evaluation will take place at the end of two years of groundwater remediation efforts. At that time a decision will be made as to whether remedial objectives for groundwater are achievable.

Finally, upon achieving the groundwater remedial objective of 5 ppb for PCE and TCE, a decision will be made by EPA to determine if groundwater is of quality that adequately protects public health and welfare and the environment.

The U.S. EPA does recommend that either the Town of Londonderry, New Hampshire and/or the State of New Hampshire develope legislation capable of preventing the present and future use of the on site aquifer. Existing groundwater protection and water supply rules at the State level may be employed to assist in attaining this objective. This restriction should be effective until the aquifer on site has been restored to levels protective of public health and welfare and the environment.

COMMUNITY RELATIONS

The Londonderry, New Hampshire community first became interested in the Tinkham Garage site in January 1983 when the drinking water wells servicing the Londonderry Green Apartment complex and several residences along Mercury Drive were closed. This occurred when volatile organic compounds were discovered in the water. A temporary source of water was provided to affected residents until November 1983, when a permanent waterline from the neighboring town of Derry, New Hampshire was fully installed. At the time, there was a high level of concern in the site area over the health and safety impact of exposure to and ingestion of contaminated water. These concerns have dissipated largely because of the waterline installation and successful use of a new, permanent waterline.

Some residents, however, remain concerned about the possibility of contamination showing up in wells along Ross Drive that are currently clean. EPA has stated that, if the Ross Drive wells show contamination, this might be considered an immminent threat to public health and that, with emergency funds, EPA could provide an alternate water supply for those residences.

In October 1985, the Londonderry Green Apartments began to be sold as condominiums. One month later, all of the units had either been sold or were in the process of being sold. The name of the development was changed to Woodland Village.

Woodland Village condominium owners have been and continue to be concerned about their potential liability for the contaminated soils and groundwater on their property. EPA has explained that under EPA's Superfund program present site owners are considered to be responsible parties. EPA attorneys have added that EPA has discretion, however, in deciding which parties to pursue for recovery of cleanup costs.

A public informational meeting to describe the FS alternatives and to respond to citizens questions was held at the Londonderry Junior High School in Londonderry, New Hampshire on August 14, 1986. The meeting was well attended by citizens, local officials and legal representatives of potentially responsible parties. On August 26, 1986 a public hearing was held at the same location to record comments by any interested parties. Comments were given by the First Congressional District Director of U.S. Representative Bob Smith, the New Hampshire Water Supply and Pollution Control Commission (NHWS&PCC) and the Chairman of the New Hampshire Toxic Hazards Campaign. Written comments were received by the Cannons Four Sites Steering Committee, and past owners of the Londonderry Green Apartment Complex during the remainder of the comment period. The formal, three week comment

period to accept oral and written comment on the feasibility study alternatives took place from August 15, 1986 to September 5, 1986. These comments and EPA's responses are included in the attached responsiveness summary. In addition, the comments are summarized below. Also included in the responsiveness summary is a section on remaining community concerns, which summarizes questions the community raised during the RI/FS process, but were not submitted as formal comments. The EPA and State should be aware of these concerns as they prepare to undertake remedial design and construction at the Tinkham Garage site.

Both Representative Smith and the Administrator of the NHWS&PCC urged a total and complete cleanup of the Tinkham Garage site. The NHWS&PCC Administrator concurred with the conclusions of EPA's Feasibility Study (FS) and, while Representative Smith did not state a preference for any particular remedial alternatives, he did express his confidence with them.

The Chairman of the New Toxic Hazards Campaign raised several questions regarding the remedial alternatives and stated that she was dismayed that vacuum extraction was not considered as a source control technology.

With regard to source control, the Cannons Four Sites Steering Committee commented that the soil pile and leachfield areas do not pose a significant risk to the public, and that access to the area behind Tinkham's garage should be restricted. If it is determined that soil remediation in the garage area is needed, the Steering Committee favors in-situ aeration.

The Steering Committee also suggested that pumping groundwater directly to the Derry wastewater treatment plant is their recommended management of migration technique. The Committee does not support air stripping or metal pretreatment.

The past owners of the Londonderry Green Apartment Complex support source removal in the area behind Tinkham's garage, which they believe is the major source of the site contamination. They also suggest that EPA consider seriously the no-action management of migration remedial alternative.

TINKHAM GARAGE SITE

Londonderry, New Hampshire

RESPONSIVENESS SUMMARY

The U.S. Environmental Protection Agency (EPA) held a public comment period from August 15, 1986 until September 5, 1986 for interested parties to comment on EPA's July 31, 1986 draft Feasibility Study (FS) for the Tinkham Garage site. The draft FS examines and evaluates methods for cleaning up hazardous wastes identified at the site.

A responsiveness summary is required by Superfund policy for the purpose of providing EPA and the public with a summary of citizen comments and concerns about the site, and EPA's responses to those concerns.

The community relations responsiveness summary for the Tinkham Garage site in Londonderry, New Hampshire is divided into the following sections:

I. Overview. This section lists the proposed remedial alternatives as presented in EPA's draft FS and summarizes public reaction to the alternatives.

II. Background on Community Involvement and Concerns. This section provides a brief history of community interest and concerns regarding the Tinkham Garage site.

III. Summary of the Major Comments Received during the Public Comment Period and EPA Responses to these Comments. This section categorizes both written and oral comments received from the community, State officials, Federal officials, and potentially responsible parties on the remedial alternatives. EPA responses to these comments are also provided.

87

IV. Remaining Concerns. This section describes community concerns raised during the public comment period that EPA and the New Hampshire Water Supply and Pollution Control Commission should be aware of as they prepare to undertake the remedial design and remedial action at the Tinkham Garage site.

Attachment A is also included as part of this responsiveness summary. It identifies the community relations activities conducted by EPA during the remedial response activities at the Tinkham Garage site.

I. RESPONSIVENESS SUMMARY OVERVIEW

A. Remedial Alternatives as Proposed in the Draft FS

The draft FS describes several remedial alternatives that are judged by EPA to be the most effective for dealing with the contamination found at the Tinkham Garage site. The remedial alternatives are organized into two categories: 1) source control, and 2) management of migration. The purpose of source control remedial alternatives is to address areas of soil contamination on the site. The purpose of the remedial alternatives for management of migration is to address groundwater contamination on the site. EPA will select one source control remedial alternative and one management of migration alternative. At the time of the public comment period EPA had not indicated its preferred alternatives. A listing of the two categories of the remedial alternatives is provided below.

1. Source Control Remedial Alternatives

   There are four source control remedial alternatives designed to address soil contamination on the site. These alternatives are:

   - o no action;
   - o excavation of soil and onsite treatment;
   - o excavation of soil and offsite incineration; and
   - o excavation of soil and offsite disposal in a RCRA landfill.

2. Management of Migration Remedial Alternatives

   There are three management of migration remedial alternatives designed to address groundwater contamination at the site. These alternatives are:

   - o no action;
   - o removal/extraction and onsite air stripping with discharge to groundwater or the Unnamed Tributary; and
   - o removal/extraction/onsite air stripping and offsite treatment at a public wastewater treatment plant.

B. Public Comments on the Remedial Alternatives

The five parties who submitted formal comments to EPA during the three week public comment period are: U.S. Representative Robert Smith (New Hampshire District 1); Administrator of the Hazardous Waste and Groundwater Protection Division of the New Hampshire Water Supply and Pollution Control Commission (NHWS & PCC); Chairman of the New Hampshire Toxic Hazards Campaign; Cannons Four Sites Steering Committee; and past owners of the Londonderry Green Apartment Complex.

Both Representative Smith and the NHWS & PCC urged EPA to conduct a total and complete cleanup of the Tinkham Garage site. The NHWS & PCC concurred with the conclusions of EPA's FS and, while Representative Smith did not state a preference for any particular remedial alternative, he did express his confidence in them.

The Chairman of the New Hampshire Toxic Hazards Campaign raised several questions regarding the remedial alternatives and stated that she was dismayed that vacuum extraction was not considered as a source control technology.

The Cannons Four Sites Steering Committee stated that, in it's opinion, the soil pile and leachfield areas do not pose a significant risk to the public and that access to the area behind Tinkham's garage should be restricted. If it is determined that soil remediation in the garage area is needed, the Steering Committee favors in-situ aeration.

The Steering Committee also suggested that pumping groundwater directly to the Derry wastewater treatment plant should be the recommended management of migration technique. The Committee does not support air stripping or metals pretreatment as part of the remedial alternative involving the Derry wastewater treatment plant.

The past owners of the Londonderry Green Apartment Complex support source removal in the area behind Tinkham's garage, which they believe is the major source of the site contamination. They also suggest that EPA consider seriously the no-action management of migration remedial alternative.

II. BACKGROUND ON COMMUNITY INVOLVEMENT AND CONCERN

The Londonderry, New Hampshire community first became interested in the Tinkham Garage site in January 1983 when private residential drinking water wells servicing the Woodland Village condominiums and several residences along Mercury Drive were closed due to the discovery of volatile organic compounds in the water.

Since then, community involvement and concern at the Tinkham Garage site has focused primarily on the following issues:

- o health and safety effects of contaminated water; and
- o liability of condominium owners.

A. Health and Safety Effects of Contaminated Water

EPA provided a temporary source of water to residents with contaminated wells until November 1983 when a permanent water line from the neighboring Town of Derry, New Hampshire was installed by NHWS & PCC.

At the time, there was a high level of community concern about the health and safety effects of exposure to and ingestion of contaminated water. These concerns have dissipated largely because of the installation and successful use of the new permanent water line.

Some residents, however, remain concerned about site contamination spreading to wells along Ross Drive that are currently clean. EPA has stated that if the Ross Drive wells show signs of contamination (they are being monitored regularly by EPA) the contamination might be considered an imminent threat to public health and, with emergency funds, EPA could provide an alternate water supply for those residences.

B. Liability of Condominimum Owners

In October 1985, the Londonderry Green Apartments began to be sold as condominiums. One month later all of the units had either been sold or

were in the process of being sold. The name of the development was changed to Woodland Village.

Woodland Village condominium owners have been and continue to be concerned about their potential liability for the contaminated soils and ground water on their property. EPA has explained that under the Superfund statute, present site owners fall within the legal definition of liable parties and could be considered to be potentially responsible parties. EPA attorneys have added that EPA has discretion in selecting parties to pursue for recovery of cleanup costs. Present enforcement negotiations concerning the site do not include individual condominium owners as responsible parties.

The community continues to be concerned about the spread of groundwater contamination to Ross Drive and the liability of condominium owners. These issues have been raised repeatedly at public meetings and have received considerable attention from EPA.

III. SUMMARY OF MAJOR COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD AND RESPONSES TO THE COMMENTS

Comments raised during the Tinkham Garage site public comment period are summarized briefly below. The comment period was held from August 15, 1986 to September 5, 1986 to receive comments on the draft FS. Comments are categorized by source of comments (e.g., the community, State officials, Federal officials, and potential responsible parties). At the time of the public comment period, EPA had not selected preferred alternatives for source control or management of migration.

A. Comments from the Community, State Officials, and Federal Officials

The Chairman of the New Hampshire Toxic Hazards Campaign (the Campaign) raised several concerns regarding the remedial alternatives proposed in the draft FS. After commenting, the Chairman stated that none of the alternatives proposed by EPA would meet the new Superfund regulations as set forth in legislation, currently pending in Congress.

Representative Smith and the New Hampshire Water Supply and Pollution Control Commission (NHWS & PCC) both stated that they preferred a total and complete cleanup of the site. NHWS & PCC agreed with the conclusions of EPA's draft FS while Representative Smith expressed his confidence in them without stating a preferred remedial alternative.

1. Source Control Remedial Alternatives

   a. Comment: The Campaign is concerned that, when EPA is excavating soil or digging into water on the site, volatile compounds will escape into the air. The Campaign asked if there would be a bubble placed over the area to prevent this from occurring.

      EPA Response: EPA does not intend to place a bubble over the site to prevent air emissions from occurring. If at any time air emissions exceed acceptable levels, soil processing will be terminated and re-evaluated by EPA.

b. Comment: The Campaign made reference to the Verona site in the midwest where a vacuum extraction system was used to remove volatile compounds from the soil without disturbing it. The Campaign asked why such a system was not considered for the Tinkham Garage site.

EPA Response: A vacuum extraction system was considered at the Tinkham Garage site and was eliminated in the initial screening of alternatives. Please refer to Section 3 of the draft FS. In-situ aeration was eliminated because of the following reasons:

- o the lov permeabilities associated with the contaminated soils at the site;
- o the high water table at the site that could cause operational problems of the treatment system; and
- o the difficulties in controlling air emissions.

c. Comment: The Campaign was concerned that, for aeration and composting, carbon will not remove some of the chemicals, such as acetone and tetrahydrofuran, from the soil and the air.

EPA Response: Carbon is not used to remove contaminants from the soil in aeration or composting. Soil sampling results indicate that currently, these compounds are either present in very lov levels in the soil source areas or not present at all. Collected air emissions will be passed through a vapor phase carbon adsorption unit to adsorb any acetone and tetrahydrofuran which might be admitted into the air.

d. Comment: The Campaign is concerned about the ability to stop the composting process should the heat cause an open fire, and questioned the possibility of the process generating enough heat to release the volatile compounds from the soil.

EPA Response: The heat generated by the composting process is not of sufficient temperature to result in an open fire. The heat and microbial action will result in the breakdown and release of volatile compounds from the soil.

e. Comment: The Campaign is concerned about air pollution, after soil washing, in the drying process.

EPA Response: Soil washing will take place in an enclosed structure. This will limit air emissions. If any air emissions did occur during the soil washing they would be controlled by implementing engineering controls.

f. Comment: The Campaign asked, if source control alternative 3 were chosen, would all or part of the soil be disposed at an offsite incinerator.

EPA Response: The answer is both. Certain portions of soil may be so small or large in volume that they may not be suitable for incineration. This soil may be sent to a landfill rather than incinerated.

g. Comment: The Campaign stated that it would be unfair to take waste from one backyard and put it in another, as suggested in source control alternative 4.

EPA Response: EPA's policy is to pursue response actions that use treatment, reuse, or recycling rather than land disposal to the greatest extent practicable. Where remedial measures include offsite storage, treatment, destruction or secure disposition, such measures must be more cost-effective than other remedial measures, create new disposal capacity in compliance with Subtitle C of RCRA, or be necessary to protect public health, welfare or the environment from a present or potential risk which may be created by further exposure to substances.

2. Management of Migration Remedial Alternatives

a. Comment: The Campaign is concerned that the carbon filter proposed for the groundwater removal/extraction and on-site air stripping system will not remove all of the contaminants and that the air leaving the system will not be clean. The Campaign also stated that water discharged to the ground has to conform to state groundwater permitting laws and be of drinkable quality.

EPA Response: The groundwater treatment systems will be designed to be capable of removing the contaminants to safe levels for discharge to surface water or to groundwater. The air emissions can and will be controlled. These groundwater treatment systems will be designed to meet Federal and State air and water treatment standards.

3. General Comments

a. Comment: The NHWS & PCC stated that it is in agreement with the conclusions described in the RI/FS, and is committed to a total and complete cleanup of the site.

EPA Response: It is EPA's intent to select the appropriate extent of remedy from among the alternatives that will achieve adequate protection of public health, welfare and the environment.

b. Comment: U.S. Representative Robert Smith submitted that he supports moving forward with the Tinkham Garage site cleanup on a positive, fast track. He stated that the success of cleaning up the Tinkham Garage site will depend on safe and permanent solutions and the ability to incinerate, neutralize, or otherwise totally destroy hazardous substances in the soil and groundwater on a permanent basis. He also urged EPA to continue to monitor closely the wells on Ross Drive.

EPA Response: Consistent with EPA policy, EPA will seek a rapid site cleanup. Destructive or other advanced, innovative, or alternative technologies have been considered where appropriate. EPA's selected remedy will include both onsite and offsite long term groundwater monitoring.

B. Comments from Potentially Responsible Parties

Detailed comments were received from the Cannons Four Sites Steering Committee and from the former owners of the Londonderry Green Apartment Complex, now called Woodland Village Condominiums. Comments from these two parties are summarized below.

Comments from Cannons Four Sites Steering Committee

The Cannons Four Sites Steering Committee organized its comments in three sections: 1) source control remedial alternatives; 2) management of migration remedial alternatives; and 3) the endangerment assessment. The following major comments and recommendations were made.

1. Source Control Remedial Alternatives

   a. Comment: The soil pile and leachfield areas are currently covered and pose no significant risk to the public.

      EPA Response: Leaching of contaminants into the ground water from the soil pile and leachfield areas is a potential threat to public health and welfare and the environment. Leaching of contaminants has occurred in the past and can occur in the future. These areas will be representatively sampled during the remedial design and potential remediation will be evaluated in light of the remedial objectives for groundwater.

b. Comment: The methodology used to estimate the extent and volume of contaminated soil is not supported by the data generated in the Field Investigation Team (FIT) report, the RI, or the draft FS.

EPA Response: EPA believes that the estimate of the extent and volume of contaminated soil in the field behind the garage is based on appropriate data. Soils in the leachfields, soil pile and svale areas will be sampled as a future action at the Tinkham site. Any potential excavation will proceed according to the defined lateral and vertical extent of the soil contamination revealed by that sampling in combination with current data.

c. Comment: Access to the area behind Tinkham's Garage should be restricted. If it is determined after further study that soil remediation is required, the most reasonable source control alternative is in-situ aeration.

EPA Response: The Tinkham garage area is private property. Access to this area is restricted by the present land owner. EPA will place signs in the area stating that it presents a potential health risk and that access is restricted.

EPA disagrees that the most reasonable alternative is in-situ aeration for the following reasons:

- o The fluctuating water table, which can frequently rise above the ground surface, will cause operational problems;
- o The soils are composed of fine material with low permeability which results in restricting the effective area over which the treatment can be conducted; and
- o In-situ aeration promotes air emissions which are difficult to control.

d. Comment: Removal of contaminated soils offsite to a hazardous waste landfill or incinerator should be removed from consideration as a remedial alternative since it is is very costly compared to other techniques proposed in the draft FS.

EPA Response: EPA does not base its screening of alternatives solely on cost. See 300.68 (f) through (i) of the National Contingency Plan (NCP). Consistent with the NCP, this alternative was retained for consideration as a remedial alternative to be considered for selection.

e. Comment: The CLP data collected and used to characterize the type and level of contamination at the site was referred to as unvalidated.

EPA Responses: At the time the draft FS was prepared, not all data had been validated. Currently, all CLP data has been validated. All data used to reach the conclusions stated in the Record of Decision has been validated.

2. Management of Migration Remedial Alternatives

a. Comment: The methodology used to interpret the groundwater constituent data (such as metals and organics) and establish average and maximum values is not valid.

EPA Response: EPA believes the methodology employed is valid. The unconsolidated aquifer and weathered bedrock aquifers are hydraulically connected. It is common engineering practice to evaluate treatment alternatives utilizing worst case as well as average values. A design assessment of contaminant concentrations in groundwater will be completed during the design phase.

b. Comment: If it is determined that groundwater from the two existing production wells requires remediation, the most appropriate technique is pumping directly to the Derry wastewater

treatment plant. Metals pretreatment is not needed based on a review of metal data and Derry's pretreatment ordinance.

Air-stripping pretreatment is not needed since the majority of organics in the ground water are amenable to biological treatment.

EPA Response: Effluent discharge leaving the Tinkham site will be required to meet local pretreatment regulations for the Derry, New Hampshire privately-owned treatment works (POTW). The need for pretreatment will be determined during design and will be based on maximum concentrations of contaminants present and the dilution of the contaminants with extracted groundwater.

c. Comment: It is not necessary to use a soil flushing technique in the area of Tinkham's garage since source control remediation will effectively address over 90 percent of the organics in the area.

EPA Response: EPA will not implement soil flushing in conjunction with the selected management of migration alternative.

3. The Endangerment Assessment

a. Comment: There is no basis for future remediation of groundwater because it is not a source of drinking water.

EPA Response: The potential exists for groundwater to migrate toward residential drinking water wells. This is documented in the Record of Decision and substantiated by water level measurements taken by EPA both onsite and along Ross Drive (see Attachment B). These measurements show a hydraulic gradient in the bedrock aquifer at the site sloping toward the domestic supply wells along Ross Drive, which are currently drawing on this aquifer.

Consistent with EPA policy, groundwater should be protected for its highest benefit and purpose. Superfund's implementation of the EPA Groundwater Protection Strategy will seek rapid clean ups of all

current and potential drinking water where it is cost-effective to do so. Moreover, the NCP requires selection of remedies that are applicable or relevant and appropriate. The No Action alternative for groundwater remediation does not comply with the requirements of 40 CFR 264 Subpart F (Ground Water Protection), which are applicable and relevant requirements for this site.

Finally, neither EPA, the State of New Hampshire, nor the Town of Londonderry has the legislative authority to restrict ground water use now or in the future at the Tinkham site. This is a high growth area and future development of land on site has been proposed. EPA believes that this reason, in addition to the reasons outlined above, requires selection of a management of migration alternative that effectively mitigates and minimizes threats to and provides adequate protection of public health, welfare and the environment.

b. Comment: Two of the three scenarios developed to determine the magnitude of risk associated with soil contamination are based on the highly unrealistic premise that children have access to soil at depths greater than one foot below the surface. In the absence of additional analytical data, no quantification of risk is possible either for the soil pile or the leachfields.

EPA Response: Risk estimates presented in the Endangerment Assessment are based on the possibility that children can gain access to contaminated soils. EPA can not definitively discount this possiblity. However, the need for excavation and treatment of the soils in these areas, as well the swale area, will be based on the potential of soils to contribute to groundwater contamination. The extent of any remediation in these areas will be consistent with the remedial objectives for groundwater.

Comments from Former Owners of the Londonderry Green Apartments

The former owners of the Londonderry Green Apartment Complex, now called the Woodland Village, submitted comments and recommendations on three documents: 1) the FS; 2) the endangerment assessment; and 3) the RI. The major comments are summarized below.

1. FS Comments

a. Comment: The no-action management of migration alternative should be chosen at the site of the condominimum complex because a permanent drinking water supply is currently in use and no contamination has migrated past site boundaries.

EPA Response: The potential exists for groundwater to migrate toward residential drinking water wells. This is documented in the Record of Decision and substantiated by water level measurements taken by EPA both onsite and along Ross Drive (see Attachment B). These measurements show a hydraulic gradient in the bedrock aquifer at the site sloping toward the domestic supply wells along Ross Drive, which are currently drawing on this aquifer.

Consistent with EPA policy, groundwater should be protected for its highest benefit and purpose. Superfund's implementation of the EPA Groundwater Protection Strategy will seek rapid clean ups of all current and potential drinking water where it is cost-effective to do so. Moreover, the NCP requires selection of remedies that are applicable or relevant and appropriate. The No Action alternative for groundwater remediation does not comply with the requirements of 40 CFR 264 Subpart F (Ground Water Protection), which are applicable and relevant requirements for this site.

Finally, neither EPA, the State of New Hampshire, nor the Town of Londonderry has the legislative authority to restrict ground water use now or in the future at the Tinkham site. This is a high growth area and future development of land onsite has been

proposed. EPA believes that this reason, in addition to the reasons outlined above, requires selection of a management of migration alternative that effectively mitigates and minimizes threats to and provides adequate protection of public health, welfare and the environment.

b. Comment: It is premature to consider groundwater treatment options until the potential effectiveness of source control measures are assessed. Taking this action in advance of any other is the most logical alternative. It is possible that source control measures alone could provide as effective a cleanup as any of the management of migration options.

EPA Response: It is EPA's intention to proceed with groundwater treatment only after completion of source area excavation.

c. Comment: All of the available hydrogeologic data indicates that the primary source of chemical contamination to the bedrock aquifer is the soil behind Tinkham's garage, not the other source areas as set forth in the draft FS. Removal or treatment of the contaminated soils behind the garage is recommended.

EPA Response: EPA agrees with the assessment that the soil behind Tinkham's garage is the primary source of chemical contamination to the bedrock aquifer at this time. However, this does not preclude the excavation and treatment of other potential source areas.

d. Comment: The estimate of the volume of soil requiring remedial action is questionable due to inconsistencies in the method of calculation.

EPA Response: EPA believes that the estimates of the volumes of soil requiring remedial action are appropriate. Actual excavation of soils will be determined in the field and will be based on the remedial objectives set forth in the Record of Decision.

e. Comment: There is concern that the scope of work for the draft FS contained assumptions regarding methods of remedial action before appropriate response objectives had been established.

EPA Response: EPA and its contractors have experience based on work at several Superfund sites nationwide. Given the site data and other information presented in the RI, it was possible for EPA and its contractors to prepare a preliminary listing of remedial technologies that might be applicable at the Tinkham Garage site. The listing in the scope of work was not a full list of the remedial technologies considered by EPA in the draft FS.

f. Comment: Task 5 of the draft FS scope of work does not state the origin of the baseline risk assessment and no references are made as to its preparation.

EPA Response: Task 5 of the scope of work for the draft FS contains a paragraph which states that the response objectives and criteria will be based on results of the baseline risk assessment, RI, and data gathered in the draft FS. Rather than detail the methods for developing the criteria, the FS states that it will adhere to Section 300.68 of the National Contingency Plan (NCP), EPA guidance "Guidance on FS under CERCLA, June, 1985, 40 CFR Part 264 (RCRA)", and the requirements of any other applicable Federal, State or local statutes.

2. Endangerment Assessment

a. Comment: The public health impacts to residents of the condominium complex are not likely to be significant based on the low concentrations of contaminants, their limited distributions in the condominium complex area, and the minimal potential for exposure.

EPA Response: Sources of potential exposure to contaminants in the condominium complex include the leachfields, soil pile, swale soil source areas, and the Unnamed Tributary. EPA cannot definitively

rule out the potential for direct contact/ingestion of contaminated soils. The Unnamed Tributary indicates low levels of contamination in surface waters and sediments. These levels are not considered to pose a significant risk to public health, welfare and the environment.

3. RI Comments

a. Comment: There is no data presented to support the assessment that zero drawdown occurred in well LGAW during the pump test. There is no indication that a standpipe was placed on the well to measure changes.

EPA Response: The comment is correct; a standpipe or stickup was not used for monitoring well LGAW. The artesian flow from well LGAW was observed during the pump test and no apparent decrease in discharge was noted.

b. Comment: Several borings were screened continuously through multiple geologic strata. This practice may obscure the relationship between units with regard to contaminant distribution.

EPA Response: In the course of drilling, EPA contractors frequently observed (by field chemical screening) that the zone of maximum contaminant concentration in a number of borings was situated at the overburden/bedrock interface. The highly fractured upper bedrock often supports considerable groundwater flow and can be considered hydraulically connected to the overburden. Furthermore, the overburden thickness in much of the study area is less than ten feet, making the installation of separate overburden wells/piezometers inappropriate.

c. Comment: The explanation for the presence of concentrations of VOCs in well LGAW is inadequate. No significant concentration of VOCs is reported in the surficial soils nearby and there is no evidence of a mechanism for downward transportation of material.

EPA Response: The presence of leachfields which EPA believes was used for the disposal of hazardous wastes near well LGAW, combined with the relatively thin sandy overburden in this area, suggest that downward migration of contaminants cannot be ruled out.

d. Comment: Estimated fracture locations in boring FW-15D noted during drilling do not correspond to fracture locations identified as a result of borehole logging.

EPA Response: Small fractures which could not be detected during the air rotary drilling were detected using geophysical logging, particularly caliper logs.

e. Comment: The borehole geophysical logging did not determine the orientation of most of the fractures at the site. The way in which the contaminants migrate between parallel faults is not demonstrated.

EPA Response: The USGS borehole televiewer work was the only borehole technique designed to provide information on fracture orientation (at the intersection of the fracture and the borehole). The geophysical data, combined with other structure information indicates a strongly preferred fracture orientation and a secondary roughly perpendicular set of fractures.

f. Comment: The greater concentrations of VOCs observed in the field behind the garage, together with vertical gradient patterns and the presumed orientation of the fracture, indicate that the garage area is probably the most significant source area.

EPA Response: Source areas associated with the condominium complex cannot be dismissed as potential sources of continuing groundwater contamination. Potential removal of these areas will be determined during design.

g. Comment: The task of conducting permeability tests at each new monitoring well location was not fulfilled. Therefore, the potential for soils in the source areas of the condominium complex to allow migration of contaminants was not fully assessed.

EPA Response: The reason that in-situ permeability tests were conducted only in certain new wells was that the minimal (less than ten foot) thickness of overburden in some locations made such testing infeasible. It should be noted, however, that split-spoon samples of overburden were collected at all locations for visual screening (and some laboratory testing) and that the drilling cuttings were monitored throughout the borehole drilling.

h. Comment: The RI fails to discuss the performance or result of the tracer study.

EPA Response: After much discussion, EPA and its contractor agreed that the proposed tracer study was not warranted at the time, since the required information could be developed more cost-effectively through other investigative means.

VI. REMAINING CONCERNS

This section describes community concerns that EPA and the State should be aware of as they prepare to undertake the remedial design and remedial action at the Tinkham Garage site.

A. Concerns About Gardening

Throughout work at the site, several residents have been concerned about the health and safety impacts of eating vegetables grown in the soil near the site. While EPA has answered that it is safe to grow vegetables as long as muncipal water is used to water them, residents are still confused about whether or not to grow vegetables. It is expected that this question will be raised again.

B. Concerns About Remedial Construction and Air Pollution

One resident expressed the concern that the remedial construction will create nuisances in the neighborhood such as loud machinery and increased traffic. This will likely become more of an issue as EPA moves closer to the actual remedial construction.

Several residents have expressed the concern that some of the onsite remedial treatments may contribute to air pollution because of the emission of volatile organic compounds.

C. Concerns About Residential Construction

Several residents have stated their concerns that residential construction in the site area and on the site may stir up contaminated soils and also affect groundwater flow. Construction of onsite remedial measures will contribute to this concern.

ATTACHMENT A

COMMUNITY RELATIONS ACTIVITIES CONDUCTED AT THE
TINKHAM GARAGE SITE

Community relations activities conducted by EPA at the Tinkham Garage site to-date include the following:

- Prepared a community relations plan in April 1983.

- Conducted onsite discussions with seven residents in Londonderry, NH, on November 20, 1985 to solicit community concerns regarding the site.

- Distributed a fact sheet explaining the RI to the community on December 20, 1985.

- Held a public meeting on February 5, 1986 at the Londonderry High School to describe the results of the RI, to discuss the upcoming FS, and to answer questions from the community. Approximately 60 people attended the meeting. At the meeting, EPA distributed copies of the RI fact sheet, a fact sheet summarizing the Endangerment Assessment, and a fact sheet describing the FS process and activities planned for the FS.

- Held telephone conversations during the week of July 21, 1986 with three Londonderry residents active at or affected by the Tinkham Garage site. The purpose of the telephone calls was to maintain contact with residents and to ascertain community concerns prior to the FS public meeting.

- Distributed a fact sheet on July 28, 1986 describing the draft FS and the remedial alternatives under consideration for the Tinkham Garage site.

- Held a public meeting on August 14, 1986 at the Londonderry Junior High School to explain the FS process and proposed remedial alternatives, and to respond to citizen's questions. Approximately 40 people attended the meeting.

- Held a public hearing on August 26, 1986 at the Londonderry Junior High School to record comments by any interested parties. A transcript of this hearing is available at the Londonderry Town Hall and the Leach Public Library in Londonderry. Three parties read comments in the record.

- Held a public comment period on the proposed FS cleanup alternatives. It lasted from August 15, 1986 to September 5, 1986.

ATTACHMENT B

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION I

DATE: July 14, 1986

TO: Tinkham Garage Technical Data File

FROM: David P. Frasca DPF
Project Manager

THRU: David Lang DL
Hydrogeologist

SUBJ: Water Level Measurements - Tinkham Garage Site and Ross Drive.

On June 27, 1986 water level elevations in both, wells on site and Ross Drive were collected and compared. The purpose of this comparison was to determine if the potential exists for contaminated groundwater to migrate from the Tinkham Site to residential wells in use along Ross Drive.

To date it is believed contaminated groundwater in the overburden aquifer migrating from the garage area is discharging to the wetlands area in the southeast portion of the site. Contaminated groundwater in bedrock is believed to travel in a fracture zone approximately parallel to Ross Drive. This water is believed to discharge to the unnamed tributary in the western portion of the site, and to the ground surface from a number of freely flowing bedrock wells on site.

The question has been raised as to the possibility of contaminated groundwater migrating perpendicular to the deep bedrock fracture zone toward residential wells along Ross Drive, in secondary fractures and in overburden. Based on the comparison of water level elevations taken from the Tinkham site and Ross Drive, and based on the orientation of the bedrock, the potential does exist for groundwater to migrate from Site toward residential wells along Ross Drive. However, it should be stated that due to the uncertainties associated with the direction of groundwater flow in fractured rock, definitive understanding of flow direction based solely on water level measurements are not conclusive. A more detailed study, possibly utilizing tracer compounds or sophisticated geophysical techniques would be required to fully characterize this flow.

Technical data collected and analyzed follows.

111

Water Level Measurements
Tinkham Garage Site
Londonderry, New Hampshire
June 27, 1986

Well Number	Time	Elevation to Top of Casing (feet)	Depth to Water (feet)	Water Level Elevation (feet)
FW-10	950	291.09	5.16	285.93
FW-10D	955	292.36	21.41	270.95
FW-11	1015	282.57	2.69	279.88
FW-11D	1025	282.82	10.40	272.42
FW-12	1115	279.33	6.83	272.50
FW-13	1055	279.48	5.71	273.77
FW-22D	1340	253.54	6.18	247.38
*FW-25D	-	282.44	-	-
FW-26	1145	285.40	3.83	281.57
FW-28D	1040	272.32	7.84	264.48

* Unable to obtain water level elevation due to obstruction in well.

Water Level Measurements
Tinkham Garage Site - Ross Drive
Londonderry, New Hampshire
June 27, 1986

Well Number	Time	Elevation to Top of Casing (feet)	Depth to Water (feet)	Water Level Elevation (feet)
3 Ross	1558	288.41	53.13	235.28
8 Ross	1550	279.98	34.14	245.84
11 Ross	1544	249.72	19.80	229.92
16 Ross	15.2	241.92	12.48	229.44
17 Ross	1539	235.19	2.63	232.56
32 Ross	1533	257.05	39.03	217.97

1. 3 Ross Drive - Thompson
   Well Type: bedrock
   Depth: 250'
   Yield: good

2. 8 Ross Drive - Cimini
   Well Type: bedrock
   Depth: unknown
   Yield: low

3. 11 Ross Drive - Warnick
   Well Type: bedrock
   Depth: unknown
   Yield: good

4. 16 Ross Drive - Bechard
   Well Type: bedrock
   Depth: 200'
   Yield: 20 gpm

5. 17 Ross Drive
   Well Type: bedrock
   Depth: unknown
   Yield: good

6. 32 Ross Drive - Marquis
   Well Type: bedrock
   Depth: unknown
   Yield: 8 gpm